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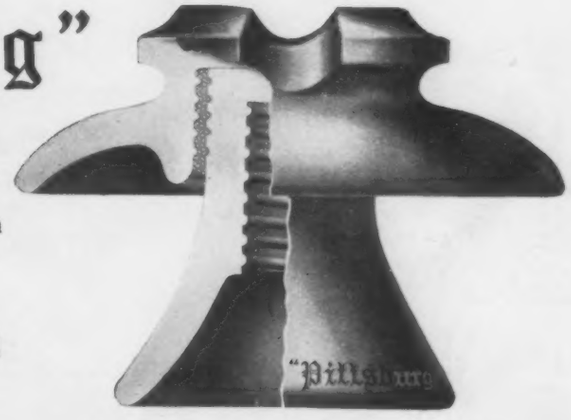

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXIX | SAN FRANCISCO, DECEMBER 28, 1912 | NUMBER 26

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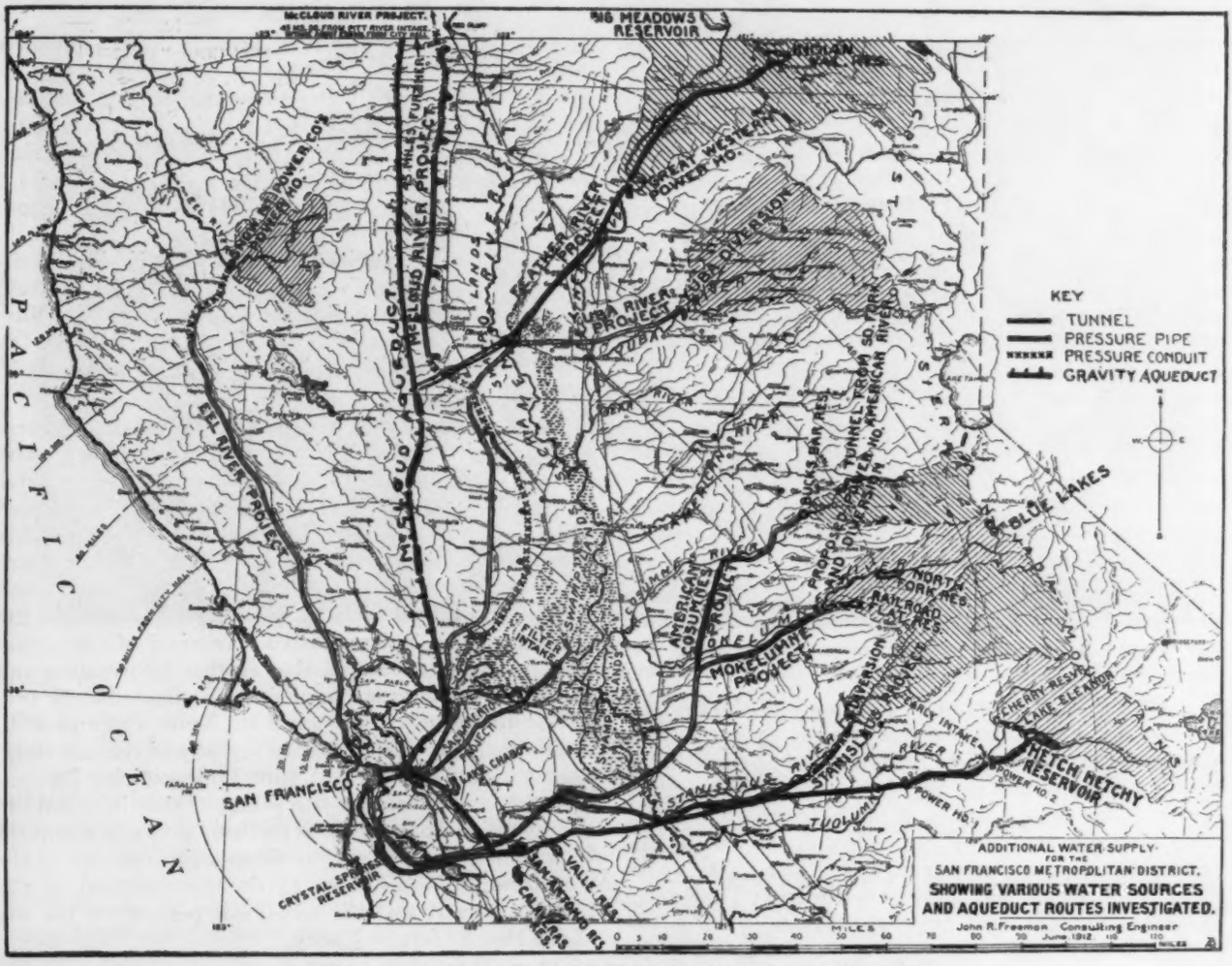
SAN FRANCISCO'S PROPOSED WATER SUPPLY

BY RUDOLPH W. VAN NORDEN.
Member A. S. C. E., A. I. E. E.

The problem of a supply of water for use in the city of San Francisco to augment or replace the present supply and provide for a future increased demand as the population shall increase has intermittently confronted the people of that city like the fireballs discharged from a roman candle. Lurid presentments of the question have been followed by lulls as the problem has seemed to be settled, only to have a new phase presented, to end in a final splurge which dies in a chaos of darkness. It would seem that final stand on the question has now arrived, and it is to be hoped that some definite movement may be taken in which prejudices, private interests and half-truths may be swept away by a clear and broad understanding of the subject, enabling the immediate solution of a really big and far-reaching problem, in a manner which will at once be good engineering practice, serve the highest utilitarian end and produce the fairest treatment to all.



A Map of the Many Proposed Water Sources for San Francisco.

The holding in suspense by the Secretary of the Interior his final decision is full of meaning. It is beyond question to believe that any motive could permeate this action aside from the desire to attain the greatest welfare for all concerned, and it is with the greatest anticipated interest that many people look forward to the report and decision to be rendered by the United States Advisory Board of Army Engineers who have made a study into the Hetch Hetchy source of supply, as well as the many other sources apparently available.

The hearing before the Secretary of the Interior, Hon. Walter A. Fisher, is reported to have been interesting in many ways, but entirely unsatisfactory both from the point of view of the city and also to the Secretary. This matter had been delayed for consideration by the Secretary of the Interior upon the proviso that the city of San Francisco make a study of all of the projects which have been offered for a municipal water supply. It was directed last spring that reports on the various projects be presented to the board of United States Army Engineers to enlighten the Secretary upon the various merits and objections to all projects presented. The Secretary desired this information to enable him to judge as to whether the Hetch Hetchy source was the only feasible one available, in which case he would be justified in issuing the desired permit, notwithstanding the various objections which have been brought against the project.

In compliance with this request by the Secretary of the Interior the city of San Francisco, already committed to the development of the Hetch Hetchy project, employed a board of advisory experts to make careful and complete reports upon all projects presented. Notably among this corps of experts was Mr. John R. Freeman, a well-known hydraulic engineer of Providence, R. I., who, having been previously in the employment of the city of San Francisco, worked out an entirely new plan for the development of the Hetch Hetchy project to the full capacity of the watershed, and to provide for a future consumption not only for San Francisco, but also the east bay cities. His report embraced the entire collection of reports hitherto presented to the city.

These reports were recently officially presented to the United States Advisory Board of Army Engineers, and it was on the basis of the showing made that the hearing at Washington was held.

The official transcript of testimony of the hearing has not as yet been made public, except for extra typewritten copies which were made for the Spring Valley Water Company and for the city of San Francisco, the two most interested parties at the hearing. San Francisco was represented by James Rolph, mayor; M. M. O'Shaughnessy, city engineer; Percy Long, city attorney; T. S. English, assistant city attorney; Thomas E. Havens, assistant city attorney; James Phelan, ex-mayor, and the following engineering experts: J. H. Dockweiler, John R. Freeman, Cyril Williams, Allan Hazen, Prof. George Whipple, of the Massachusetts Institute of Technology, Desmond Fitzgerald, chief engineer of the Boston Water Works, and George Fuller, filtration expert.

The Spring Valley Water Company was represented by their veteran consulting engineer, Hermann Schussler, E. J. McCutcheon, attorney, F. C. Hermann, chief engineer, and George Anderson, the well-known consulting engineer of Denver. The Turlock and Modesto irrigation districts, who are the principal objectors to the use of water from the Tuolumne, were represented by Luther Waggoner and Henry T. Cory, both well-known consulting engineers. The Modesto district was further represented by its engineer, Burton Smith, and its attorney, B. H. Griffin. The Turlock district was further represented by Mr. H. S. Crowe, its engineer, and Mr. Jones, attorney.

The Sierra and Blue Lakes Water Company, one of the alternative projects offered to the city, was represented by a local Washington attorney.

The McCloud Aqueduct Company, who have presented an alternative project, was represented by Mr. A. L. Shinn, an attorney of Sacramento and San Francisco.

The nature-lovers, those who object to the use of the Hetch-Hetchy Valley as a reservoir from esthetic reasons, were the editor of the Century Magazine, Mr. Geo. Macfarlane, of Chicago, president of the American Civic Association; Prof. William Frederick Bade, of the Sierra Club, and one or two others.

The army board was represented by Colonel Biddle, Major Crosby, Colonel Taylor and its secretary, Mr. Wadsworth. Secretary Fisher had the following advisory board of engineers: General W. L. Marshall, consulting engineer to the Secretary of the Interior; M. O. Leighton, head of the water resources branch, United States Geological Survey; Otis H. Smith, director United States Geological Survey; F. H. Newell, director United States Reclamation Service; Mr. Marshall geographer United States Geological Survey; Dr. Rupert Blue, head of the United States Marine Medical Corps.

The hearing consisted largely of the city's representation of the Hetch Hetchy project and was interspersed with many questions by the Secretary. After the testimony was all taken the Secretary expressed himself as not satisfied with the showing on possible alternative projects, and intimated that the San Francisco representatives were pleading a cause rather than stating full impartial facts covering all phases of the question, as he had requested. In view of this situation, the Secretary asked that further information and data covering alternative projects be immediately presented to the advisory board of Army Engineers, to enable that board to make its report and recommendations to the Secretary. A time limit expiring December 23d, was given for the filing of this information, and it was intimated that if this was properly complied with a final decision might be speedily reached in the withdrawal of objections to the continuation of the Garfield permit and the additional permit for the use of the Hetch Hetchy Valley.

Brief History of Municipal Water Supply.

The history of this water question is unique. It has covered a period of forty years, and the many phases which have been presented, the maze of complications of every sort and hue, the false scents and

decoys, efforts at exploitation by promoters of various projects, mountainous objections which turned out to be molehills and insidious shadows, which have stealthily grown into stone wall obstructions, half-truths or absolute misstatements; many indeed presenting a kaleidoscopic curtain to obscure the true solution of the problem.

The first attempt at a water supply for San Francisco was made by the Mountain Lake Water Company in 1851. It was proposed to use a small lake at the west boundary of the Presidio Reservation, and take the water from Lobos Creek, through which the water from Mountain Lake passed into the outer entrance of the Golden Gate. Six years later the San Francisco Water Works was organized, and the water from Lobos Creek was brought around the northern part of the city by tunnel and flume to Black Point, whence it was pumped to various reservoirs. The Spring Valley Water Works commenced operations by using the water from a spring at Mason and Washington streets in 1858. In 1862 this company, having been strengthened financially, brought water to the amount of two million gallons per day from Pilarcitos Creek, in San Mateo County. The old San Francisco Water Works was purchased by the Spring Valley Water Works, later known as the Spring Valley Water Company, in 1865. In 1867 a series of litigations were commenced with the city, which have continued in a greater or lesser degree ever since.

In 1876-7 Lake Merced, which lies southwest of the city, near the ocean, was introduced into the system, and development was commenced on the famous Crystal Springs dam, in San Mateo County. This dam was sixteen years in construction. A period of low water, threatening a water famine, resulted in the introduction of the Alameda Creek supply in 1886-8. This was brought across the bay from Dumbarton Point in two sixteen-inch submerged pipes. These were supplemented in 1901 by two twenty-two-inch pipes, and artesian wells were developed in the Pleasanton Valley. This brought the supply up to about 35,000,000 gallons per day.

The Middle Falls of the McCloud River.
(These waters are being urged as a possible source of water supply for San Francisco.)

The city of San Francisco began to make investigations for a municipal water supply as early as 1870, following a season of unusually low water. On April 10, 1871, a committee was appointed by the Board of Supervisors to make a report. This committee consulted General B. S. Alexander, Corps of Engineers, U. S. A., and Prof. Geo. Davidson, United States Coast Survey, who made a report on December 11, 1871, as follows:

"That the water sources of the peninsula within reasonable distance are amply sufficient to furnish an abundant supply of good, pure, fresh water to provide

for the wants of San Francisco for at least fifty years."

It is interesting to note in this connection that only fifteen years after this date the Spring Valley Water Company introduced water from Alameda County. The years 1872-3, threatening a water famine, revived the subject of municipal ownership and a new water supply. This resulted in an investigation and surveys of the Blue Lakes, in the Sierra Nevadas, Clear Lake, Calaveras Creek, in Alameda County, and other peninsula sources, with a resulting report and a recommendation favoring the acquisition by the city of Calaveras Creek. While the city was negotiating for this purchase the Spring Valley Water Company, alive to its opportunities, stepped in and purchased the rights to the use of this water. This site has never been developed, and is advanced by the Spring Valley Company as a very large additional resource to increase the capacity of its system, suitable for a supply for many years to come. In 1876-7 another dry season prompted another set of investigations and surveys under the direction of Colonel Geo. H. Mendell, Corps Engineers, U. S. A., embracing the sources which had been suggested up to that time. This examination covered the Spring Valley sources, Clear Lake, Lake Tahoe, El Dorado Water and Deep Gravel Mining Company's properties, on the south fork of the American River; Blue Lakes, in the Mekolumne watershed; Rubicon River, a tributary to the south fork of the middle fork of the American River; the San Joaquin, the Feather River and Lake Merced. In this year the Spring Valley Water Company offered its properties to the city for $16,000,000. A counter offer by the city of $11,000,000 was rejected.

The question of municipal ownership died down, due to abundant water seasons, and the additional development of water sources by the Spring Valley Water Company, until the dry season of 1897-8.

On January 8, 1900, the new city charter went into effect in San Francisco, and in accordance with its provisions an exhaustive study of the whole water situation was commenced. This study embraced the sources examined by Colonel Mendell in 1877, with the addition of investigations on the Yuba River, Feather River, Sacramento River, Eel River, Stanislaus River, Tuolumne River, Bay Shore Gravels, and the Bay Cities Water Company's resources. The result of this investigation by the board of public works and city engineer was a report finding the Tuolumne River, using the Hetch Hetchy and various other tributary reservoir sites as by far the most satisfactory source for a municipal water supply from every point of view. Abundance, purity, greatest storage, freedom from adverse water rights and large power possibilities.

Water location filings were made in July, 1901, at the outlet of the Hetch Hetchy Valley, on the Tuolumne River and at Lake Eleanor, on Eleanor Creek, in the name of James D. Phelan, then mayor of San Francisco. Refilings were made in 1908 at these points to comply with amended plans for development. Application was made to the Secretary of the Interior for the right to build reservoirs and occupy United States land for a canal line. These rights were denied by the Secretary on January 20, 1903. The Secretary granted a rehearing and again denied the rights on December 22nd of the same year, but with the recommendation that an appeal be made to Congress, he claiming that the law of October 1st, 1901, did not authorize such a grant. At this time strong opposition was put forward to the granting of these rights by the Spring Valley Water Company, and also by representatives of the Modesto and Turlock irrigation districts, who claimed that the taking of the waters for the supply of San Francisco would interfere with the development of these irrigation districts.

A bill was then drafted and introduced in Congress and was there referred to the Committee on Public Lands, from which apparently no action was gained. The matter was finally presented to the President in February, 1905, who in turn referred the matter to the Secretary of Commerce and Labor, who denied the recommendation, but from different reasons from those taken by the Secretary of the Interior. On July 27, 1905, a new and elaborate statement and argument for San Francisco was placed before the President, but before this came to his attention, while passing through the office of the President's secretary, was sidetracked, and turned over to the Secretary of the Interior. This error was subsequently rectified and the matter was referred to the Attorney-General.

On October 28, 1905, the Attorney-General rendered an opinion, in which he advised the President, quoting the law of February 15, 1901, to authorize the Secretary of the Interior to permit the use of rights of way through public lands and the various national parks, including the Yosemite, in which these rights are situated, for the purpose of supplying water for domestic, public and beneficial use.

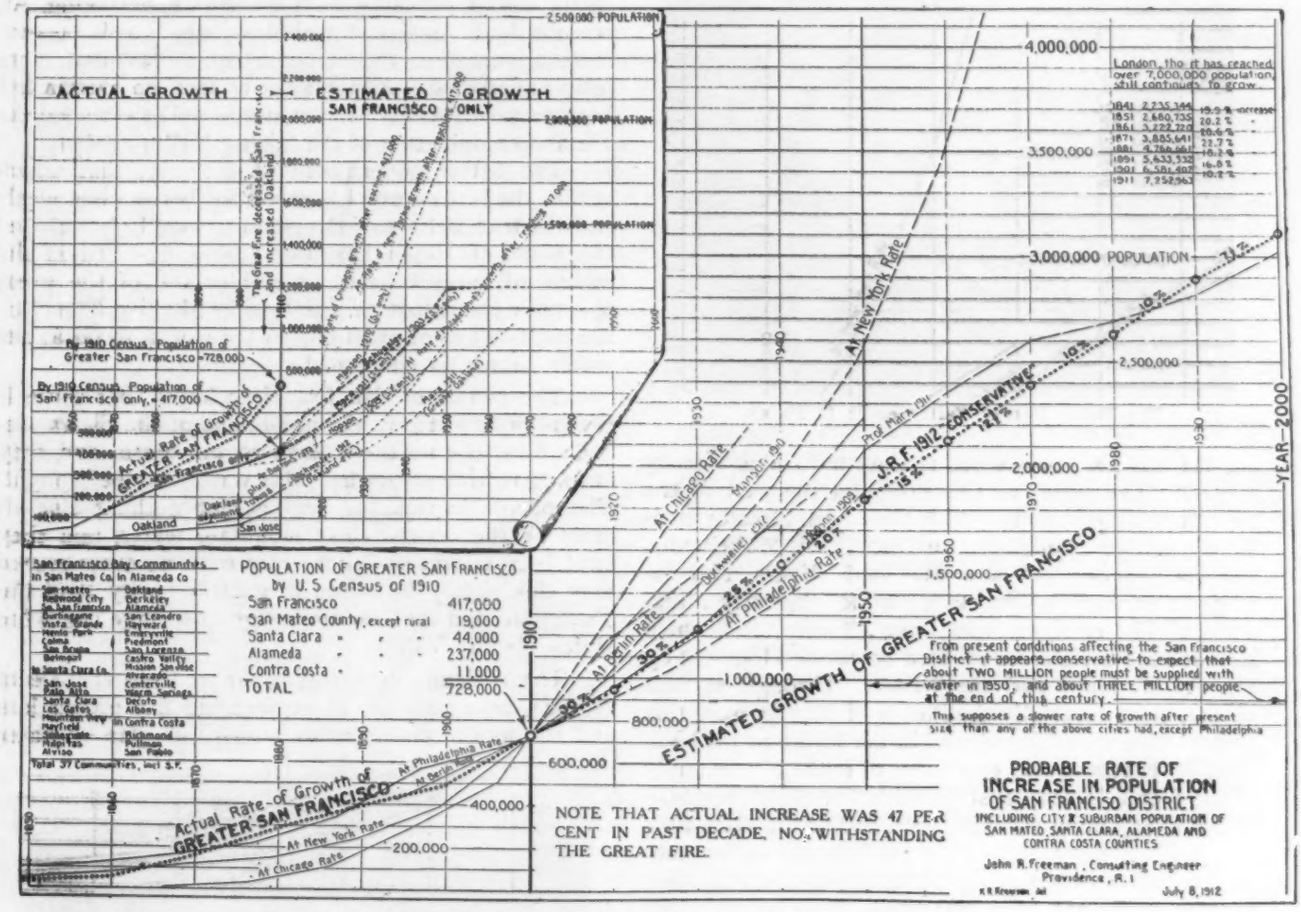
Pending these various applications for these rights the city engineer, who at that time was Mr. C. E. Grunsky, caused the Tuolumne project to be surveyed for a gravity canal, tunnels and pressure pipe lines across the San Joaquin Valley. This work was done in 1902, and an elaborate report, accompanied by maps and cost estimates, was made to the city of San Francisco. This furnishes much of the data which were subsequently used in the various plans for the development of this project. This survey did not commence at the reservoir sites, but from an intake somewhat lower down the river, but included two power plants, which utilized drops in the canal line. Subsequent surveys were made of the reservoir sites and alternative lines, by the city.

In 1906 the desired permit having not as yet been received, the Board of Supervisors of San Francisco passed a resolution enabling the city to proceed with the development of a project. About this time a New York promoter offered the supply known as the El Dorado Deep Gravel and Water Company's property, on the south fork of the American River. It included taking of water from Lake Tahoe through a tunnel under the summit of the Sierra Nevada Mountains. This offer proposed to sell to the city and conduct thereto water from this system for $35,000,000. There were a number of objections, which seeemed so evident that the offer was not seriously considered.

In this year the Bay Cities Water Company, which had already submitted a proposition to supply water from the Lower Santa Clara Valley, made a proposition

embracing the south fork of the American River and rights, reservoirs and canals, on the Consumnes River. This proposition was very well worked up and presented, and undoubtedly had some merits in its favor. The objections found were the difficulty in maintaining the watershed sufficiently free from contamination, the quantity of water, which was considerably less than it was proposed to eventually bring from the Tuolumne sources and the cost of construction of an order of excellence, which was considered necessary to maintain the purity of the water.

After this amended plan had been worked out by Mr. Manson to a degree sufficient to show to the people the immediate possibility of development and it had been decided to proceed with the work the new Secretary of the Interior, Richard A. Ballinger, after listening to representations of the various interests opposed to the project, served notice on the city to show cause why the permit issued by his predecessor should not be revoked. To meet this requirement the city has from time to time asked for extensions to properly present its case.


ACTUAL GROWTH
ESTIMATED GROWTH
SAN FRANCISCO ONLY
2,500,000 POPULATION
3,000,000 POPULATION
4,000,000
3,500,000
2,000,000
1,500,000
1,000,000
800,000
600,000
400,000
200,000
YEAR—2000
By 1910 Census, Population of Greater San Francisco = 728,000
By 1910 Census, Population of San Francisco only, = 417,000
Actual Rate of Growth of GREATER SAN FRANCISCO
Actual Rate of Growth of GREATER SAN FRANCISCO
At New York Rate
At Chicago Rate
At Philadelphia Rate
At Boston Rate
At Detroit Rate
At Pittsburg Rate
At Cleveland Rate
At Buffalo Rate
At St. Louis Rate
At Baltimore Rate
At Cincinnati Rate
At Milwaukee Rate
At Washington Rate
At Los Angeles Rate
At Minneapolis Rate
At Kansas City Rate
At Seattle Rate
At Portland Rate
At Denver Rate
At Toledo Rate
At Rochester Rate
At Atlanta Rate
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At Dallas Rate
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At Salt Lake City Rate
At Spokane Rate
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At Des Moines Rate
At Birmingham Rate
At Norfolk Rate
At Jacksonville Rate
At Rock Island Rate
At Mobile Rate
At Charleston Rate
At Savannah Rate
At Peoria Rate
At Augusta Rate
At Macon Rate
At Montgomery Rate
At Columbia Rate
At Galveston Rate
At Wilmington Rate
At Little Rock Rate
At Vicksburg Rate
At Shreveport Rate
At Meridian Rate
At Natchez Rate
At Key West Rate
At Pensacola Rate
At Tallahassee Rate
At Fernandina Rate
At Brunswick Rate
At Beaufort Rate
At Port Royal Rate
At Apalachicola Rate
At Port Tampa Rate
At Port Inglis Rate
At Port Boca Grande Rate
At Port Punta Gorda Rate
At Port Fort Myers Rate
At Port Naples Rate
At Port Marco Rate
At Port Key West Rate
At Port Miami Rate
At Port Palm Beach Rate
At Port Fort Lauderdale Rate
At Port Hollywood Rate
At Port Miami Beach Rate
At Port Coral Gables Rate
At Port Homestead Rate
At Port Florida City Rate
At Port Key Largo Rate
At Port Islamorada Rate
At Port Marathon Rate
At Port Big Pine Key Rate
At Port Key West Rate
At Port Dry Tortugas Rate
At Port Havana Rate
At Port Matanzas Rate
At Port Cienfuegos Rate
At Port Santiago Rate
At Port Kingston Rate
At Port Port-au-Prince Rate
At Port Cap Haitien Rate
At Port Santo Domingo Rate
At Port San Juan Rate
At Port Ponce Rate
At Port Mayaguez Rate
At Port Aguadilla Rate
At Port Arecibo Rate
At Port Manati Rate
At Port Barceloneta Rate
At Port Vega Baja Rate
At Port Dorado Rate
At Port Toa Baja Rate
At Port Bayamon Rate
At Port Guaynabo Rate
At Port Rio Piedras Rate
At Port Carolina Rate
At Port Loiza Rate
At Port Canovanas Rate
At Port Fajardo Rate
At Port Ceiba Rate
At Port Naguabo Rate
At Port Humacao Rate
At Port Yabucoa Rate
At Port Maunabo Rate
At Port Arroyo Rate
At Port Patillas Rate
At Port Guayama Rate
At Port Salinas Rate
At Port Aguirre Rate
At Port Jobos Rate
At Port Guayanilla Rate
At Port Penuelas Rate
At Port Ponce Rate
At Port Juana Diaz Rate
At Port Santa Isabel Rate
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At Port Ciales Rate
At Port Manati Rate
At Port Barceloneta Rate
At Port Arecibo Rate
At Port Hatillo Rate
At Port Camuy Rate
At Port Quebradillas Rate
At Port Isabela Rate
At Port Aguadilla Rate
At Port Rincon Rate
At Port Anasco Rate
At Port Aguada Rate
At Port Moca

Francisco's water supply in a manner of strictest equality to all concerned, and without fear or favor, requested of Marsden Manson, who at that time was still city engineer, that reports be made on all feasible projects for the purpose of determining whether or not there might be a more suitable project than the Hetch Hetchy, or one which would be equally suitable and without the strenuous objections which had been dur-

The Hetch Hetchy Valley as It Is Today.

ing the last six years levied against the Hetch Hetchy project. The result of this order on the part of the Secretary were reports, which have been already mentioned, on the Stanislaus, American, Eel, Mokelumne, Feather, Sacramento and McCloud Rivers, and included a variant on Grunsky's plan for the early utilization of Cherry Creek and Lake Eleanor, and which included the designs for modern power development by Mr. A. M. Hunt and the writer. Through various causes, more especially the illness of Mr. Manson, this presentation was delayed, and in the spring of 1912 Mr. John R. Freeman was employed to make a new study of the Hetch-Hetchy system, with the object, if possible, of overcoming all objections, and at the same time giving a more comprehensive exploitation of the subject, together with a study of the reports on the other sources which had been presented. This report is the one which has been recently presented to the advisory board of Army Engineers, and which, while it has brought out a refinement of the Hetch Hetchy problem, has also served indirectly to bring out the points of excellence and disadvantages of the various other projects. It, however, has gone further than this; for while it shows in a masterly way the possibility of development of one of the greatest water supply systems in the world, it has also served to increase the objection by the opponents of the project to the use of the water, and has pointed out a method of developing other systems which may be equally as good and possibly cheaper, without interfering with conflicting rights or privileges. The Honorable Secretary now demands further and more complete data on the alternative projects.

The company supplying the city has been obliged to buffet the powerful tide of public sentiment and from time to time has apparently had uphill work in holding its business against municipal encroachment. But whatever may have been its wrongs, fancied or real, whatever may have been the quality of its product and its service, it must be admitted that it has developed its system to keep abreast of the demand when it was predicted that it could not. Its works are permanent and thoroughly constructed; it has maintained the quality of water at the highest point possible, considering the nature of the supply, and it has made a game fight. It has stockholders and bondholders who have invested in good faith. The injustice of ruthlessly throwing out this system, as so many have advocated, would probably be a difficult undertaking, for reasons both legal and technical, which will become more apparent as the water situation becomes more fully understood. As a matter of fact, no system has been proposed which has not suggested or included the use and co-operation of the Spring Valley system.

The better government of the city, that which within the last decade has stood for better civic ideals and the true welfare of the commonwealth, has caused the name of Hetch Hetchy to be a by-word in the mouth of every citizen, as emblematic of the great hydraulic emancipation which will make San Francisco the most-talked-of great city in the world, so far as her water supply is concerned.

The people of San Francisco know that there is crystal pure water in the mountains of the Sierra Nevada from the northern limit to far south, and they know that from somewhere this water may be brought. The people expect and will accept nothing else—it must be the crystal clear mountain water, and they have been taught to believe that from no other source may this supply be found in greater purity than the Tuolumne, and the Tuolumne's great storage site is the Hetch Hetchy Valley.

The difficulty of bringing water from the Sierra Nevada, as a problem in engineering has grown less and less as the years during which this plan of water

The Beautiful Hetch Hetchy Valley as It Will Appear With Scenic Roads When Submerged.

supply has been considered have passed. Other metropolitan centers have embraced the benefits of engineering skill and daring, and have succeeded in constructing works fully as intricate and stupendous as the problem which confronts San Francisco, and which have been as successful and as beneficial as San Francisco expects it to be.

After much money has been spent, engineers and lawyers have been consulted, years of work in the field

and in the municipal affairs, the people, the newspapers, the city's officers, all are educated and believe, all are centered on the one desire to obtain this great supply of water. Is there any reason, then, that with such a concensus of opinion the United States Government should block such a worthy use? If there is a reason, the people want to know it. The people as a whole are fair and just. If they are wrong, if they need further enlightenment, they are ready and willing to learn. But they will not give up cherished ideals without something better than that which put the ideal there.

In the case of Hetch Hetchy there has been a more or less concerted movement on the part of a few nature-lovers to prevent the issuing of a permit to flood the valley from what they believed to be esthetic reasons. San Francisco's need is one to be blocked only by reasons of equivalent or greater weight. The nature-lovers' objection, beside being a mistaken one, is of no weight against San Francisco's need. It has been amply discussed elsewhere. It does not, on its face value, enter the question here. As a matter of fact, few people, aside from what they read from time to time in the newspapers, and these articles are seldom accurate, or give a true view of the situation, have anything but the vaguest conception of the problem or its status at any time, and this holds true even to technical men, whose interest for engineering problems keep them alert for new things.

The Freeman Plan for the Development of the Hetch Hetchy Water.

Mr. Freeman was authorized to make a report which would analyze the situation from start to finish. The Secretary, on presentation of a petition signed by the mayor and advisory water commission, on May 13, 1912, granted an extension of time until July 15 to file additional and complete data and to permit objectors to the use of the Hetch Hetchy to present their views with respect thereto.

Mr. Freeman was familiar with the ground to be covered, and had, in fact, put much thought on the proper solution of the problem, and was further convinced that the Hetch Hetchy supply would not only fill every requirement that San Francisco and all the bay cities might have in the next one hundred years, but he also became convinced that the methods of development which had been thentofore adopted, while satisfactory for a small or partial development, were not suitable either from an economic point of view or from one of permanency and the proper protection of the flow with a more comprehensive plan which he had evolved. After a final careful study of every phase of the situation in the spring of the present year, it was decided to make his report embrace the new plan. This report of nearly 400 pages, quarto size, is a most elaborate and exhaustive treatise covering the subject from the hygienic and sanitary, as well as the engineering side. It is profusely illustrated with views of dams and reservoirs of many noted systems in different parts of the world. Route maps and profiles are shown in whole and in detail in a most thorough manner. Throughout the estimates of cost, with profuse references are brought out in a most lucid manner, and the results are startling in showing what can be done in the very substantial manner prescribed with the many trying conditions to overcome.

To the main report there are twenty appendices, compiled, with four exceptions, either by engineers working in conjunction with Mr. Freeman or by independent engineers. These appendices, in their order, are on the following subjects:

1. Municipal Progress Report for Co-operation in Water Supply.
2. An Act to Provide for the Incorporation, Organization and Management of Municipal Water Districts.
3. Present Resources Supplying Oakland, Alameda, Berkeley, etc.
4. Dependable Additional Supply from Alameda Creek, By John B. Freeman.
5. Abstract of a Report on Underground Supply. By J. H. Dockweiler.
6. Doctrine of Percolating Waters. By Percy Long.
7. Inadequacy of Spring Valley Supply. By H. A. Noble.
8. Basis for Estimate of Capacity and Cost of Hetch Hetchy Project Aqueduct and Tunnels. By John R. Freeman.
9. Preliminary Estimate of Cost of Hetch Hetchy Project. By Horace Ropes, in consultation with John R. Freeman.
10. Cost Estimate of Stanislaus River Project. By C. E. Grunsky.
11. The American-Consumnes Project. Abstract from report of J. H. Dockweiler.
12. Report of Filtered Supply from Sacramento River. By Allen Hazen.
13. A Proposal to Furnish Water from the McCloud River. Comment by C. E. Grunsky; notes by C. E. Grunsky Jr. and John R. Freeman.
14. Eel River as a Source of Water. By C. E. Grunsky.
15. Feather River Investigation. By C. E. Grunsky and N. A. Eckart.
16. Yuba River as a Source of Supply. By C. E. Grunsky.
17. Abstract of a Report on Turlock-Modesto Irrigation Districts. By J. H. Dockweiler.
18. The Mokelumne River as a Source for San Francisco. By C. E. Grunsky.
19. Tuolumne River Gaugings.
20. Report on Properties of Spring Valley Water Company. By J. H. Dockweiler.

It is apparent from the discussions reported from the recent hearing that the appendices covering projects antagonistic or alternative to the Hetch Hetchy project have not been satisfactorily presented, either through lack of detail, insufficient information, or conjecture not based on facts.

In their present shape they bear out the long held contention of San Francisco that no other project could be substituted for the Hetch Hetchy. This was brought out by the Secretary who is quoted as intimating to the San Francisco delegation that they were pleading a cause and not offering an unbiased solution of the problem by giving for the decision of the Honorable Secretary a complete exposition of every claim.

Original Plans of Development.

In both the Grunsky and Manson plans of 1902 and 1910-11 it was proposed to divert the flow of the Tuolumne River about seven miles in the latter instance and fifteen miles in the former, below the Hetch Hetchy Valley, carry the flow in open canal along the

mountainside, except for occasional tunnels, but utilizing a gravity flow. In the earlier plan there was to be a drop and power plant in Bear Gulch, and a second plant at a drop near Dry Creek. The Hetch Hetchy dam was to be built to a height of 150 ft. and dams in Cherry Creek and Lake Eleanor (a natural lake, but of little value without a dam to increase the depth) to a height of 150 ft. In the Manson plan it was proposed to develop the two smaller lakes first, having the permit for these only, from the Department of the Interior. It was proposed to take the combined flow from these lakes in an open canal to North Mountain, on the north bank of the Tuolumne, about seven miles below the Hetch Hetchy Valley outlet, and there dropping to the river, develop power. It was also intended to take the natural flow, diverted by means of a low dam sufficient to make the diversion at the Hetch Hetchy outlet, carry this along the south bank of the river in an open canal and drop through the same power house, as the Eleanor-Cherry water. The water was to be again diverted into a canal which would drop the water taken from the main river higher up, through a power station situated at the junction of the south fork with the main river, this flow being returned to the river to supply the irrigation districts below. The equivalent of the Eleanor-Cherry flow was then continued in canal and tunnels to Bear Gulch, where it was to be dropped through the third power house and from here it was to be continued in gravity canal and tunnel with some sections of pressure pipe to Dry Creek, where it was again dropped through the fourth power house. From this point the water was to be taken into two 50 in. pipes, a distance of 62 miles, across the San Joaquin Valley to a pumping station to be operated by power transmitted from the power plants. Here the water was to be pumped to an elevation of 675.5 ft., from whence it was carried through a long tunnel and then pipes, through the Livermore Valley, thence through the Alameda hills, across the Bay of San Francisco and then up the peninsula to the city. This plan contemplated the delivery of 60,000,000 gallons daily to San Francisco and ultimately of about 300,000,000 gallons, when completed to full capacity.

The Freeman report contemplates a development on a broader scale and it was with three cardinal points in view that this plan was developed. He realized that the water necessity would in time be as great on the east side of the bay as the west and that eventually a metropolitan district would be formed. The total consumption of water on the San Francisco peninsula is now nearly 40,000,000 gallons per day and could be greater, while that of Oakland, Berkeley and Alameda is over 27,000,000 gallons per day. With the rapid growth of population down the peninsula and on the east side, the bringing in of 60,000,000 gallons, together with present sources, unless they be developed further, would soon be met. He has calculated that in 25 or 30 years, at least 200,000,000 gallons daily will be required and that in 100 years, this will be more than doubled, besides developing the present supply reserve sources to the utmost. The plan therefor contemplated an ultimate supply to require all of the available storage and he estimated this to be 400,000,000 gallons daily. The next important consideration was the absolute retention of the purity of the water found in the high mountains,—the partial object of going so high up. Pipe and tunnel offered the most permanent solution of retaining the flow at all times without contact with the open air or any other source of contamination and to prevent chemical action and lower the friction factor, these must be smoothly lined with concrete. The third important consideration was, by maintaining the line under pressure for practically the entire distance, to make possible the flow from the force of gravity alone, without resorting, as in the previous plans, to pumping. The power which it is still proposed to generate is to be used for municipal purposes.

It is proposed to build all tunnels of a capacity to carry the entire future flow of 400,000,000 gallons daily; but, for the present, the pipe lines which are eventually to be in duplicate will carry about one-half this amount, while the final section of pipe from the connection to Crystal Springs reservoir into San Francisco will have a capacity of but one-eighth, or 50,000,000 gallons, and a like amount, when desired, into the Crystal Springs reservoir. For this latter amount it is not necessary to build a high dam in Hetch Hetchy valley, but only one of about 150 ft. in height, about as originally proposed by Grunsky. It is not proposed to build either the Cherry or Eleanor dams at present. It is for so much of the development that the cost was found to be about $37,000,000.

As the demand increases, it is proposed to drive a tunnel from the conduit to Lake Chabot which supplies the Oakland system, or to run a line of pipe directly to Oakland.

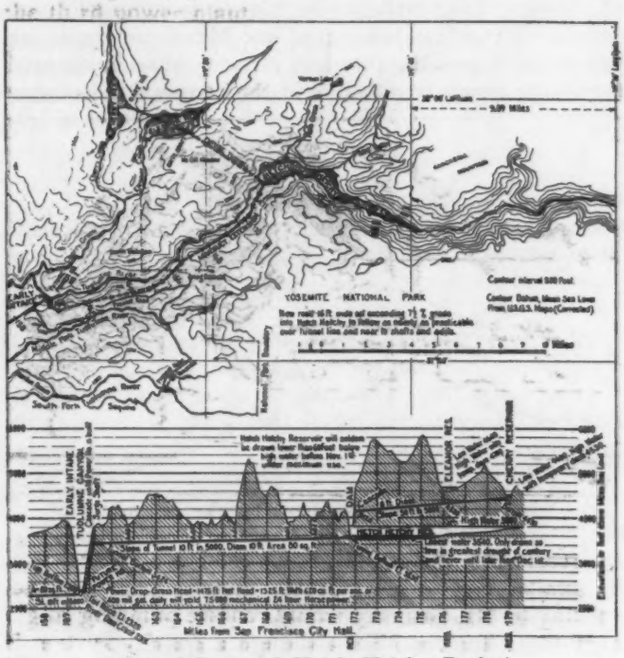
When the demand reaches one-half of the capacity projected or, possibly, a maximum of 240,000,000 gallons, it will have been necessary to build low dams, 50 ft. in height in both Eleanor and Cherry Creek, giving a total storage of 65,300,000,000 gallons. For the complete development, it will be necessary to build the dam in the Hetch Hetchy Valley to a height of 300 ft., making a storage of 110,000,000,000 gallons, and build the Cherry and Eleanor dams to their full height, and also to build a dam in the Poopenout Valley 250 ft. high to store 17,000,000,000 gallons. This will bring the total cost of the project according to a summation of Mr. Freeman's figures to about $75,000,000, not including the cost of the Spring Valley system which is intimately worked into the Freeman plan.

The plan contemplates diverting the water at first at Early intake, about 12 miles below the Hetch-Hetchy Valley, into a tunnel which, with one interruption, where the south fork is crossed, is carried to Moccosin Creek (this is further west than Bear Gulch.) Here a drop is made and the water will eventually pass through a power plant. From here it enters a tunnel, crosses the Tuolumne in a steel pipe line, thence through a tunnel to Dry Creek. From this point the San Joaquin Valley is crossed by two pipe lines (eventually) and these are carried up the west side to a surge tank at the hydraulic grade. Thence passing through a series of tunnels and pipe siphons to the Irvington gate house. From here pipes carry the water across San Francisco Bay and up to the

Crystal Springs reservoir, or on an alternative plan, directly to San Francisco delivering into the proposed San Miguel or the University Mound reservoirs. The Oakland flow is taken as already stated.

It is not proposed to construct the first 12 miles of the conduit unless it should be found that, flowing in the river bed is contaminating, or until the second power plant is built, which will be placed at the Early intake.

Upon the development of the Cherry-Eleanor reservoirs it is proposed to bring their waters into the Hetch-Hetchy reservoir through an unlined pressure tunnel which will pass through a mountain of solid granite. At the foot of this tunnel will be located the third power plant.



Inlet of Proposed Hetch Hetchy Project.

The amount of power which can be developed by this system is large, amounting to over 150,000 h.p. It should be remembered, however, that this amount of power cannot be generated until the full flow of the conduit shall have been established or until the entire storage capacity is developed. This of course might be many years in the future. With the flow of 50 to 100 million gallons daily, power would be only proportional and comparable with the amount proposed to be developed in the earlier plans.

It is interesting to note in this connection that in at least two of the alternative possibilities, the Indian Valley (Feather River) and the McCloud, a large amount of power may be developed immediately, whether the water be carried to the bay cities in full quantity or not.

Objections Raised Against Hetch-Hetchy Project.

With all other desired points feasible and possible, the principal objectors to the use of the Tuolumne water are the irrigationists who depend on the river for their water, the Spring Valley Water Company, who, unless their system be purchased would be liable to lose a large part of their business, holders of conflicting rights, and the proponents of alternative projects. No attempt will be made here to treat with the latter three, but the former situation is vitally imporant and forms the basis for the entire discussion.

Modesto and Turlock Irrigation Districts.

These irrigation districts lie to the south and to the north of the Tuolumne River, respectively, and get their water supply from a common diversion at La Grange. Here is the highest overflow dam in the world and one of the most famous. The amount of land now under irrigation is about 130,000 acres, but the amount possible to irrigate in the districts and which must depend upon this water supply is 258,000 acres. In addition to this there are lands outside of the districts which if they are ever developed, must get water from the Tuolumne River and cannot get it from any other source. This brings the total acreage to 460,000. It has been claimed by Mr. Freeman and others that the land now irrigated has been and is being over-irrigated. While this is probably the case, it must be remembered that practically no water or very much less than is needed is delivered through the months of July, August and September. In order then to properly irrigate, there must be provided storage and it is this feature that the U. S. Reclamation Service is carrying out in many parts of the country and undoubtedly would be interested in doing here. Intricate reports and calculations have been made as to the adequacy of the source to supply both the irrigation districts from the natural flow and some storage and the San Francisco supply from the flood storage. The question asked in all fairness by the irrigators, that seems to be overlooked is this: "If the highest use of this water is to provide not only for present needs of a metropolitan district but for 100 years to come, should not the ultimate development of the lands which are bound to be populated in time be also provided for?"

A casual perusal of the tables of yearly run-off shown in U. S. Water Supply paper No. 299, pp. 267,-270, shows, in a five-year period from October, 1895, to October, 1900, an average of 1,590,000 acre ft. of water, the maximum being 2,440,000 acre ft. and the minimum 960,000 acre ft. Taking, however, the three-year period from 1897 to 1900 the average is less, being 1,310,000 acre ft. The outside maximum storage capacity in the watershed is calculated to be 700,000 acre ft., which cannot store over 75 per cent of the run-off.

A study of the Turlock-Modesto lands by several irrigation experts has shown that to properly irrigate the soil a depth of 3½ ft. of water gross per year is necessary. On the assumption that this is correct, the amount of water necessary for the land irrigated at present, for the entire district and for the total area which must get water from this source is as follows:

130,000 acres now irrigated, 455,000 acre ft.

258,000 acres in the combined districts, 905,000 acre ft.

460,000 acres, all lands subservient, 1,610,000 acre ft.

A continuous flow to San Francisco of 400,000,000 gallons per day is equivalent to 448,900 acre ft. per year. It is immediately seen by inspection that if all the lands are to be fully irrigated there would on this average, be no water for San Francisco and in

some years not nearly enough for irrigation. There is always a possibility that the official stream gaugings do not account for much water in maximum flood conditions, but this is conjecture. The above is the sort of plain argument that frightens the irrigationists.

At the recent hearing, the attorney for the districts is reported to have stated that no objection would be raised to the storage and use of flood waters by San Francisco, provided San Francisco would sell to the districts at a price to cover the cost of storage, sufficient water during the low period of flow, for their needs. This is reported to have been agreed to by the San Francisco representatives, until such time as the city should need the water. Such an agreement could not be accepted. The question therefor gets back to the starting point, can San Francisco get water, equally as well elsewhere, or if not, is its need a preference over that of irrigation which cannot be had in any other manner?

There are at least two adverse claims for the use of the Tuolumne water for power purposes and for which the Hon. Secretary has been applied to for permits. Undoubtedly these must receive consideration and might have better claim to the use of the water, for power only, than San Francisco.

Alternative Projects.

Some of the alternative projects notably the filtration of Sacramento River water the Indian Valley (Feather River) and the McCloud aqueduct, more especially the latter, are reported to have received considerable consideration in the recent hearing. The remaining projects were apparently not seriously considered, as on the face, they were assumed to lack the desirable features to be found either in the Hetch Hetchy or the above named alternatives.

Mr. Freeman has grouped the projects in two groups. Those whose water can be brought to San Francisco in a conduit across the upper end or around the head of San Francisco Bay, and those which must perforce, cross both the Sacramento River and the Bay of San Francisco between Oakland and that city.

The Stanislaus River Supply.

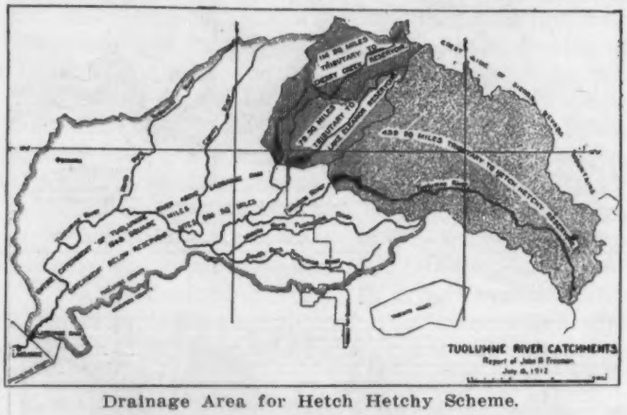
This belongs to the first of the groups and would be very similar in its conduit to the Hetch Hetchy, the Stanislaus being the next watershed to the north of the Tuolumne. Appendix No. 10 by Mr. C. E. Grunsky is a report on this project. This conceives a pipe and pumping system somewhat similar to the original Hetch-Hetchy plan. There is on this river the power plant of the Sierra & San Francisco Power Company who have developed one of the large reservoir sites. There are no other large reservoir sites and the catchment area of about 900 square miles is more or less inhabited. The quantity of water which might be delivered to San Francisco is estimated by Mr. Grunsky to be not over 60,000,000 gallons per day, and he cites a number of disadvantages, such as the quality of the water, conflicting uses and a very large territory which must eventually be irrigated from this watershed. The cost estimated for this system is $40,000,000. So far as the writer is informed, this report covers the subject satisfactorily.

The next river north of the Stanislaus is the Calaveras on which no project has been suggested for a water supply.

The Sierra-Blue Lakes Project.

This project has its source on all three branches of the Mokelumne River, the next north of the Consumnes. The proponents of this project have been insistent in their claims and have undoubtedly drawn much favorable attention to a consideration of the value of this source.

This project is described by Mr. Grunsky in a report given as Appendix 18 in the Freeman report. The plan of development contemplates the use of the existing Blue Lakes on the south and middle fork watershed and the construction of new reservoirs on the middle and north fork. Of these the Railroad Flat site, is the most important. The proponents of this project have made strong claims to compare favorably with the Hetch-Hetchy, but Mr. Grunsky, in his report finds considerably less capacity than is claimed, for the reservoirs. Outside of the connection between



Drainage Area for Hetch Hetchy Scheme.

the reservoirs, the conduit line would in a general way be similar to the older Hetch Hetchy plan, and according to Mr. Grunsky would require pumping to get over the Altamont hills, although a gravity system is also suggested. There is a large amount of land amounting to about 200,000 acres dependent upon this watershed for irrigation which forms a factor of objection, fully as great as the one confronting the Tuolumne sources. On the north fork the natural flow has been in use by the Pacific Gas & Electric Company to furnish power for their Electra system. Mr. Grunsky finds that a daily supply of 60,000,000 gallons could be developed and that this might be increased to 200,000,000 gallons. The cost given for the former development is $30,700,000, and for the latter $78,600,000. From point of cost given this project will not compare favorably with the Hetch-Hetchy. As to quality of water and adverse claims a more thorough study of the situation will in all probability have to be made. Sufficient power may be developed to do all necessary pumping with some reserve. The proponents offered to bring this water to the east side of San Francisco Bay for $20,000,000, a sum which is probably much too small.

American-Consumnes Project.

This project was well exploited in 1906-7 and was close to receiving favorable consideration from the city. It proposed to take water from the south fork of the American and connect this with the Consumnes, the river which lies to the south of the American and next north of the Mokelumne. This project was ad-

vanced by the Bay Cities Water Company and an abstract of a report for present uses is included in Appendix No. 11 by Mr. J. H. Dockweiler. This report is exhaustive and the conclusions are, that for the delivery through a system, substantially similar to the earlier Hetch-Hetchy plan, 60,000,000 gallons daily could be developed for the sum of $36,800,000, and that an all gravity conduit, requiring no pumping, similar to the Freeman plan for the Hetch-Hetchy would cost, for the delivery of 220,000,000 gallons the sum of $69,200,000. There is a large amount of land dependent upon this source for irrigation, amounting to 658,500 acres, but it is found that this may be irrigated and still find sufficient water by storage for the city supply as outlined. This project has received the most thorough engineering study of any of the alternatives, except perhaps the Sacramento River filtration, but due to its greater cost and limit to the supply, seems to have not been given great consideration recently.

Yuba River Sources.

The Yuba River which lies next north of the American drains a large watershed and has three main branches. The south contains many reservoir sites, part of which are developed and is owned largely by the Pacific Gas & Electric Company. It is on this fork of the Yuba that the new Lake Spaulding dam is being built. This dam, designed by the late Mr. James Wise, in consultation with Mr. Frank Baum, will be one of the highest in the world, is for the purpose of storing water to be used for a series of large power developments and for extensive irrigation.

The north fork of the Yuba offers by far the greatest volume of low water flow as well as total runoff but has few reservoir sites. It, at one time, was seriously considered as a supply for San Francisco by the formation of a large reservoir at Oregon House. The use of the water by the Pacific Gas & Electric Company's Colgate plant precludes the consideration of this source.

Between the middle and the south fork are a number of storage reservoirs built in the early days of the state for mining purposes. These reservoirs are owned by interests allied with the Spring Valley Water Company and form the basis of supply which that company has offered in connection with its other supplies in case it should be found necessary to reach to the Sierra for an additional source. This supply should be equally as good as the Hetch-Hetchy or any other in quality. The writer knows of no basis of comparison as to cost or quantity although it seems probable that the former would be somewhat greater and the latter less than the Hetch-Hetchy. No irrigation rights of any moment would be interfered with and a large amount of power could be developed.

Feather River Source.

The Feather River is the next watershed north of the Yuba and is the largest in area and in quantity of flow of any of the rivers so far named. It has four main branches and several lesser ones of considerable importance. Local interests hold the south and middle forks, and no supply proposition is known to have been projected from these sources. The north fork is the largest in point of flow and watershed and contains at least two reservoir sites of unusual value and great capacity. These sites are the Big Meadows which is being developed as the second largest reservoir in the world, by the Great Western Power Company, and Indian Valley. The latter site was examined and surveyed by the U. S. Reclamation Service in August-September, 1905. The watershed is large, covering about 733 square miles and is a wild uninhabited region. Water stored in this reservoir would have all of the purity and desirable features to be found in any of the high Sierra sources. The problem, in its general form would be like the projects already described, but this project and also the Yuba would fall in the second classification given by Mr. Freeman. It will be necessary to cross both the Sacramento River and San Francisco Bay. Indian Valley is in the Diamond Mountain Forest Reserve, but the inundated portion is patented land to the amount of probably 6000 acres which would have to be purchased. While measurements show an annual discharge much in excess of the amount to be eventually used by the city, storage would at times lessen the flow in the North Fork, thus interfering with the operation of the Great Western Company's plant at Big Bend. This company is said to be the only adverse claimant either for power or irrigation rights and in all probability an arrangement could be entered into with them to supply the power, which probably could be developed to the amount of 150,000 h.p. to them, and having them deliver over their system to San Francisco, this power, less an amount to pay for transmission and also to make up what is lost by storing water. This is the suggestion of Mr. Henry T. Cory and is undoubtedly worthy of consideration. He further proposes in crossing the Sacramento Valley in order to shorten as much as possible the line of pressure pipe to go directly to the west side and then follow the proposed gravity line of the McCloud aqueduct to San Francisco. This line of conduit would be somewhere between 200 and 220 miles in length supplying both Oakland and Berkeley and San Francisco and in any event only from 5 to 10 per cent longer than the conduit in the Freeman plan to supply both cities. No figures of cost have as yet been made but the idea is sufficiently attractive to receive some attention.

The report on the Feather River project given as Appendix 15 in the Freeman report is well described by a remark made by one who attended the Washington hearing, "A straw man set up to fall of its own weight." This report presupposes a diversion of water below the Big Bend power station and at an elevation of about 400 ft. This should be sufficient to condemn the project without the trouble of carrying the report further. Water taken at this point would of necessity have to be filtered and would probably never be accepted by the people of San Francisco under any condition. This report carries out an estimate of cost of a gravity project with a filtration system. The sum given for a supply of 60,000,000 gallons daily is $42,250,000; for 200,000,000 gallons, $92,008,000; and for 400,000,000 gallons, $171,819,000. No power could, of course, be developed, in fact this plan would be almost similar to the Sacramento filtration plan with the disadvantage of added distance and the benefit of

gravity flow. Further discussion is a waste of good space.

The McCloud River Source.

There are no rivers available in point of quantity flow or storage possibility to the north of the Feather until the McCloud is reached. The Pitt River, which should be called the main Sacramento, has immense flow and great storage possibilities, but the quality, where the diversion would have to be made, is not sufficiently pure to use without filtration.

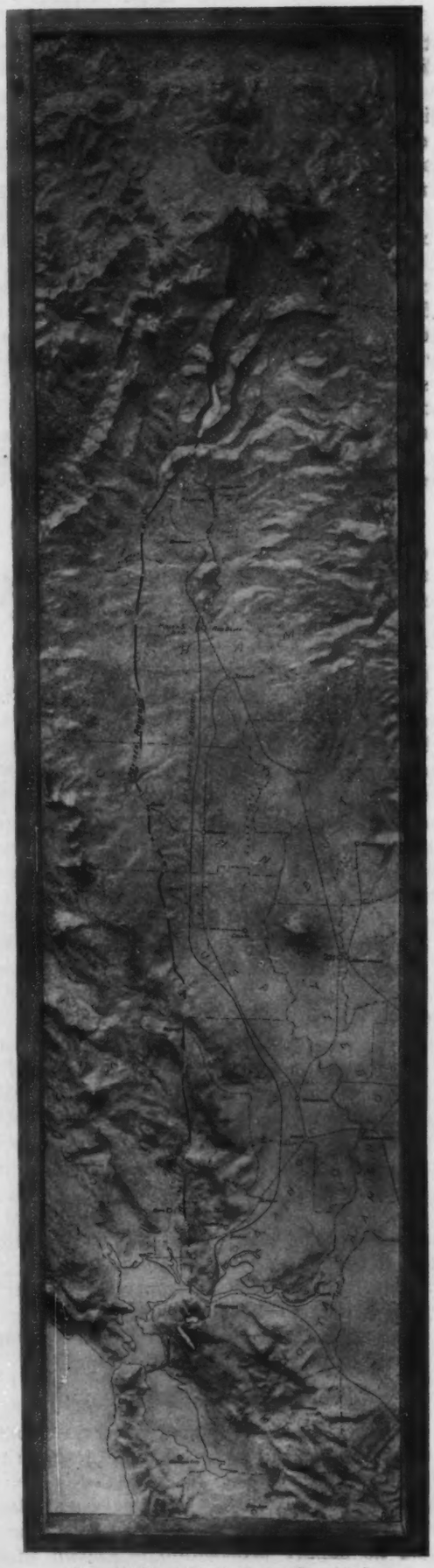
The McCloud has its source largely in the snowy slopes on the eastern and southeastern side of Mt. Shasta. The watershed covers an area of about 675 square miles and is included in the Shasta National Forest Reserve. About 70 per cent of this area is patented land and much of the territory is heavily timbered.

The nature of the ground surface is porous due to volcanic formations, and the run-off passes into the ground only to emerge in many beautiful springs to form by their cascades, the McCloud River. The purity and quality of this water is described by Mr. Freeman in his notes in Appendix 13 of his report. Probably in no source in California could the water be purer or less liable to contamination.

In the presentation of this project another "straw man," this time, wet straw, seems to have been set up. But the weakness of the presentation seems to have drawn the attention of the Hon. Secretary to its coyly hidden possibilities. The objections which have been offered were: the great distance; the possibility of contamination from lumber camps; the greater cost; the taking of water necessary for irrigation and the lack of power development possibility on the line of conduit.

The proponents of this project made a survey during 1911 from the point of diversion to Suisun, or practically the point where the conduit would follow the Hazen plan of filtration of Sacramento River water to San Francisco. This survey contemplated a pressure pipe line and gravity conduit down the Sacramento Valley and the development of enough power on the line of aqueduct to pump the water into Oakland and San Francisco. This survey was probably as accurate and thorough as any survey made by the city. When the Freeman plan for bringing Hetch-Hetchy water was developed doing away with the need of pumping, a similar plan was conceived by the McCloud proponents and it was discovered that by constructing a high line canal, water could be conveyed by gravity in open cut covered aqueduct, similar in all respects with the Los Angeles Aqueduct, and thus carried to the bay cities, the only pressure lines being under the straits of Carquinez and the bay of San Francisco. This new line, while there has not been time for a complete survey, has had a careful reconnoissance and the data available is probably as accurate as that used by the city in developing the new plan from Hetch-Hetchy, which does not follow the original surveys.

This line after crossing the Pitt River, passes through a tunnel and crosses the Sacramento River above Redding. It then follows the contour of the west slope of the Sacramento Valley, mostly in gravity concrete lined and covered conduit, to a point west



The McCloud Project as Proposed.

of Williams. From here a tunnel carries it to the Capay Valley and after following this valley for several miles another tunnel takes the conduit to the Berryessa Valley, thence by another tunnel to the eastern slope of the Napa Valley, thence to Carquinez straits. Crossing the straits in a pressure tunnel, the hydraulic grade is again assumed and the conduit terminates in the proposed Pinole and San Pablo reservoirs. From these a pressure tunnel and pipes carry the water to Oakland and San Francisco. The low cost of this project in comparison with all of the others, including the Hetch Hetchy is due to the large amount of gravity flow canal, and the relatively smaller amount of tunnel and pressure pipe.

The length of this aqueduct from the diversion to San Francsico, including the supply for the east bay cities, is about 216 miles, or 16 miles longer than the Hetch-Hetchy aqueduct for the same purpose. In casual reference to this project people have figured the railroad distance from San Francisco to Pitt, which figures to 280 miles, which has probably given rise to the idea of great distance. The proponents of the project either own or have options on 98 per cent of the patented lands which include the lumber camps. The acquisition of this area by the city gives immediate control to habitation and sanitation. The remaining two per cent consists of a game preserve and the summer homes of a few persons, two of whom, at least, are most respected citizens of the metropolitan water district.

The cost of this project, including all rights and lands, has been estimated by the writer, on the unit cost basis adopted in the Freeman report, and is, for a full development of 400,000,000 gallons, delivered to San Francisco and east bay cities, $54,624,560, which is $20,000,000 less than the summary of costs given in the Freeman report for the Hetch Hetchy system fully developed. A preliminary development for one-half of the water delivery or 200,000,000 gallons, would cost about $45,000,000, or very nearly the figure recently given out by Mr. Freeman as for a like amount from Hetch Hetchy.

This project has the disadvantage of a bay crossing, but a service line down the east side could readily be made to connect with the Spring Valley's lines. This would, of course, apply to all of the more northerly group of projects.

The U. S. Reclamation Service has calculated that the entire available supply from rivers emptying into the San Joaquin Valley would be sufficient to cover all of the irrigable land of that valley about twenty inches in depth, while the same calculation concerning the Sacramento Valley would cover the irrigable land to a depth of about nine feet (5th annual report U.S.R.S.) The rivers of the east side of the Sacramento Valley will probably supply for all time all the water necessary to irrigate land east of the Sacramento River. Those of the west side will partially irrigate the irrigable land of the west side. The use of 400,000,000 gallons by the city would probably decrease the volume of the Sacramento River at the head of irrigation not more than ten per cent, during the low water period. This still leaves enough water at the lowest period to irrigate all lands in the valley, leaving a large surplus in the river.

In the development of this project the municipal water district might by some manner be extended to take in Red Bluff, Sacramento, all of the west side towns, Santa Rosa, Napa, Vallejo, etc., and deliver water to all of these towns under heavy pressure.

So far as the city supply is concerned no storage is necessary as the minimum flow of the McCloud is about twice the amount which it is proposed to use. No power can be developed on the line of the aqueduct, but within the watershed about 120,000 horsepower may be developed immediately.

The McCloud Project Ending at Metropolitan District.

Sacramento River Filtration Project.

This project which has been ably reported by Mr. Allan Hazen and forms Appendix 12 in the Freeman Report contemplates pumping from the Sacramento River near Rio Vista with an auxiliary pumping station at Antioch, carrying the conduit through the Contra Costa hills, through Oakland, thence across the Bay to San Francisco. An alternative line passes southward and around the head of the bay to avoid the crossing. The project includes a very complete modern filtering plant.

The necessity of going so far for the water is to ensure the procuring of fresh water, the fresh water zone having a variation of about 35 miles. This conduit from the pumps to San Francisco would have a length of 51 miles. It is proposed to develop at first with a nominal capacity of 75,000,000 gallons daily. The cost of this installation is summed up for 75,000,000 gallons, $24,000,000; for 120,000,000 gallons, $42,000,000; and for 180,000,000 gallons, $60,000,000. These figures are not made on the basis of the Hetch

Hetchy figures and may be higher in comparison. From them is however seen that for the full supply necessary, any of the gravity systems would be cheaper. Further than this it is doubtful if the people as a whole would ever accept a filtered supply if a mountain source could be had. It is interesting to note in this connection that many experts favor this plan and claim that the water will be most satisfactory. In the recent hearing, Dr. Rupert Blue, than whom no higher sanitary authority probably lives, is reported to have made the statement, "That he would rather have Sacramento River water filtered than Hetch Hetchy unfiltered."

Throughout the period of planning by the city for a water supply the Spring Valley Company has stoutly proclaimed its ability to develop its resources and furnish water to the amount of 252,000,000 gallons daily to take care of the needs of the city for many years to come, besides a Sierra source. The company, through Mr. Schussler and its corps of engineers, have made thorough studies of their problem and have conducted campaigns of education before the people. Both the engineering and legal features have been thoroughly exploited by independent engineers and lawyers and the results from both sides do not always seem to coincide. The matter has been in fact, so freely and thoroughly discussed that there will be no attempt to do so here. This phase of the question is, however, one of importance and will have great weight in the final decision.

READINESS TO SERVE METHODS

ELECTRIC POWER ON THE FARM.

BY ROSS B. MATEER.

The average farmer works perhaps longer hours for a living derived from the cultivation of the soil than the man engaged in any other form of labor. He rises hours before the sun shows above the horizon and does not complete the feeding of his cattle and the chores around the house until long after the sun has set, knowing that each day throughout the year the daily routine must be performed repeatedly with little or no variation.

Fig. 1. The Typical Rural Cottage—A Fruitful Field for the Power Salesman.

Fig. 2. The Country Home on the Farm.

Cheerfully he enters into a contract with nature, knowing that the results of his labor are certain under proper climatic conditions, and that he will enjoy the perfect health with which to perform faithfully his part in forcing from the soil, the products that may be utilized as a medium of exchange or be readily converted into gold or silver.

A certain acreage is secured by a small payment and the balance covered by a mortgage on the land, the productiveness of which depends greatly upon the ease with which it yields to scientific principles of cultivation.

Grain, requiring little or no attention in its growth, is frequently that which first appeals to the farmer; grass for cattle and hay for winter feed are necessities and must be grown and cured in quantities sufficient to last an entire year. The hay must be baled and stored in weather proof sheds, the wheat or barley harvested and threshed, the straw cut in many cases by manual labor, yet almost any process that must be repeatedly performed with little or no variation can be more successfully and economically accomplished by a motor-driven mechanical device than by any other means.

The electric motor, in small sizes, has ceased to be a luxury, having reached the stage of a necessity, and within a few years will be the agent by which the greater part of the routine work on the farm is performed.

To commend itself to the farmer and his requirements, the electric motor must be economical primarily with reference to cost of operation; secondarily with reference to the space occupied and the safety and adaptability for all agricultural purposes.

A flexible cable with a plug attachment is all that is needed to connect the smaller sized units. They may readily be carried from one part of the building to another and can be easily belted to any machine, thereby providing a satisfactory combination of speeds by the use of pulleys of various sizes. When the motor is too large to carry, it may be mounted on a truck and readily drawn from the barn or woodshed to the field, where, by means of a flexible cable and connection to a convenient pole, it will operate the threshing machine. In fact, the electric motor can be located in

almost any portion of the farm, or in any building, where current is available and can be started or stopped merely by the turning of a switch. It may be placed safely with reference to convenience of the work and with little regard to the source of power.

Small individual motors are adapted to a multitude of small machines and where many are to be in use at one time and are located in one building, a satisfactory grouping results in the operation of only one or two portable units.

Fig. 3. Orchard, Tank and House to Be Electrically Supplied.

Some of the principal applications of motors on the farm consist of house pumps, corn shellers, fodder cutters, threshing machines, corn dividers, elevators, horse and sheep clipping and all dairy and household uses, resulting in safety to the operator and economy to the owner.

Operating Costs.

The question of vital importance to every farmer is not what is the investment necessary that he may increase his earning capacity and secure larger returns from his labor, but rather, what is the operating cost. How much will it cost him to pump water for his cattle and for domestic purposes? What is the cost of threshing grain? How will a motor save time and money?

To give a careful estimate of the cost, an investigation was necessary. Data available from various sources indicate that from 5 to 6 gallons of water per member is consumed; for cattle from 12 to 15 gallons per head; for swine, 1 to 3 gallons, from which the average daily consumption of water is easily determined, so that knowing the total quantity, the unit cost per thousand gallons is apparent. To pump 1000 gals. to a tank, 35 ft. in elevation, approximately one-half of a kilowatt hour is required, which, at the average rural rate of three cents per kilowatt hour, is one and one-half cents.

A threshing machine is capable of threshing, cleaning and sacking from 100 to 200 bushels in a day of ten hours and may be operated on a five horsepower motor. The larger the capacity of the machine, the greater the motor horsepower required. A machine of 800 bushels requiring a twenty horsepower motor.

The consumption in kilowatt hours per hundred bushels of grain was determined from a series of tests to be 25 kw. for rye; 22 for wheat; 19 for oats; 21 (kilowatts) for barley.

A machine with a capacity of 145 bushels per hour, operating on a 15 h.p. motor, required 0.1257 kw.-hr. per bushel and cost, including labor, interest and depreciation, $0.00377 per bushel.

Fodder cutters of a capacity of two tons per hour and operated by a motor of ten (10) horsepower, require 2.08 kw.-hr. per ton while those requiring only from one to two horsepower, consume as low as ¼ kw.-hr. per ton.

Grinding of ear corn will require 0.411 kw.-hr. per bushel, while for shelling corn 0.0448 per bushel is required.

A horse groomer easily operated in the barn, only records a consumption of 0.106 kw.-hr. per horse, or cost only $0.00318.

All the above cited examples tend to confirm the representations of the salesman who is not only earnestly seeking to interest the farmer in the use of motor operated, current consuming applications of power, but also to convince him that merely by the turning of a switch, he may economize in the monthly payroll by using less manual labor, thereby allowing him to awake in the morning and find the glorious light of another day instead of darkness meeting his opening eyes.

SWISS HYDROELECTRIC POWER DEVELOPMENT.

The past 15 years have witnessed a remarkable advance in hydroelectric power development in Switzerland. What may be called the pioneer hydroelectric plant in the Confederation was established in 1863 at Schaffhausen, on the Rhine River. The old system of cable transmission was used, and it was not until 1901 that modern electrical appliances were installed. The first plant built along up-to-date lines for hydroelectric power generation was located at Heerbrugg, in the Canton of St. Gall, and has been in operation since 1887.

Since this latter date hydraulic stations for the production of electrical energy have sprung into existence in all parts of the country, following the rapidly increasing use of electricity and the demand for cheaper power. In 1911 there were 783 electric power plants in operation in Switzerland. Of this number 473 were works which purchase power from other plants and simply resell the same, generating no energy themselves. Of the establishments producing their own power 233 were wholly or partly hydroelectric stations, and only the remaining 77 were steam or gas plants.

GIGANTIC ELECTRIFICATION IN RUSSIA.

The six principal Russian banks in concert with a powerful Belgian group, have obtained imperial sanction, for the company to be formed for utilizing the water power in Finland, including the Lesser Jmatra and three other falls, as well as the Russian fall on the Volkhov River, to supply electrical energy to St. Petersburg and environs. The scheme comprises not only lighting and power for the city and suburban industries, but for extensive undertakings like the circular electric railway round St. Petersburg and the electrification of the existing railways for suburban traffic.

ELECTRICAL PUMPING AND IRRIGATION

ECONOMY OF CONCRETE LININGS.

BY B. A. ETCHEVERRY.

While concrete linings have many advantages, it is not an economical proposition to line canals indiscriminately without considering all the factors upon which a decision should be based. The problem resolves itself into a comparison between the cost

Condition of Lining Before Application of Mortar Wash, Burbank Irrigation and Power Co., Washington.

and the benefits derived. The factors which must be considered are (1) cost of construction, (2) cost of maintenance and operation, (3) damages due to waterlogging and alkali, and (4) value of water loss.

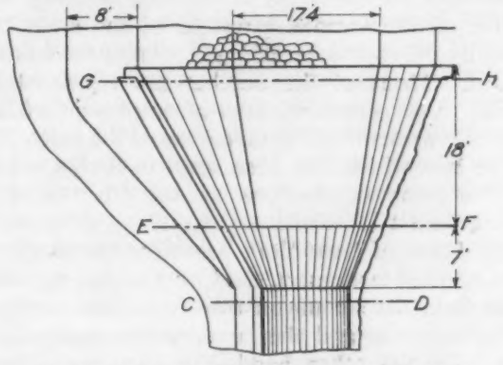
When a new canal is to be constructed the choice between an unlined canal and a concrete lined canal will depend largely on the first cost of construction. When there is sufficient fall available, a concrete lined canal can be given a steeper grade than an unlined canal which could not resist the erosion due to high velocity. The steep grade and also the smoother cross section will give a high velocity which will make the necessary size of the canal much smaller. The concrete lined ditch can also be given steeper side slopes which will decrease the excavation. For these reasons the amount of excavation, especially on side hill work, will be much smaller for the concrete lined canal than for the unlined canal, and this will reduce the cost of excavation sufficiently to balance for at least a part of the cost of lining, and in some cases where the excavation is in hard material, the concrete lined canal may cost less than an unlined canal. Where there is not sufficient fall available to give the lined canal a steep grade, the comparison will not be quite as favorable but even then a lined canal because of its smooth bed and sides will have a greater velocity than an unlined canal on the same grade, and therefore a smaller cross section, and on side hill work in hard material the saving in cost of excavation will be considerable. Other benefits which must be considered are the decreased cost of maintenance and operation ,and the greater safety. There are no weeds to contend with, no breaks to mend and consequently the cost of patrolling is eliminated. To this must be added the value of the water saved and the prevention of waterlogging of the land below a leaky ditch. These benefits can not be closely estimated when a new canal is to be constructed but should be considered before deciding the feasibility of a concrete lining.

With existing canals the problem is to prevent the seepage losses, or to increase carrying capacity by either enlarging the canal or by lining it with concrete. The extent of the seepage losses can be obtained by measurements, the damages done to adjacent land below and the maintenance of the canal are fairly well known and will furnish sufficient data to estimate what can reasonably be spent in concrete lining. When the capacity of the canal must be increased, the choice is between making a larger unlined canal or to use a lined canal of smaller cross section which will have a higher velocity because of the smoothness of the sides and bed. There are many cases where the value of the water loss alone will justify the improvement of the canals by lining. This is obtained when the value of the water loss will be equal to or larger than the depreciation and interest on the capital invested. As an illustration, if a canal carrying 50 cu. ft. per second throughout the irrigation season of 4 months or 120 days, loses 3 per cent per mile, which is not excessive, this loss is equal to a continuous flow of 1.5 cu. ft. per second or 3 acre

Canal Lined With Semi-Circular Reinforced Concrete Sections Joined in the Field, Tieton Canal, Washington.

ft. per day, which gives a total of 360 acre feet whose value at $1.50 an acre foot is $540. For this case we would be justified in spending per mile a capital the interest of which plus depreciation is equal to $540 If we assume interest and depreciation at 8 per cent, the capital is about $6000. In most cases this would

be more than enough to build a concrete lined canal of that carrying capacity, depending on the velocity which can be used.



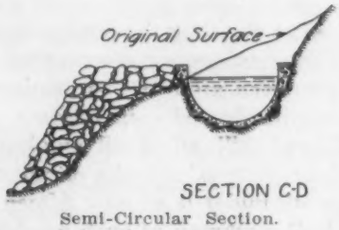
Junction of Canal With Flumes and Tunnels.

The assumed seepage loss of 3 per cent for a canal carrying 50 cu. ft. per second is often exceeded with small canals, and on most irrigation systems there are always some sections of canals which would warrant concrete lining. A general formula which gives the thickness of lining justifiable for different conditions is the following: Where

$$t = \frac{sQv}{16.3\ pci}$$

t = thickness of lining in inches.
s = the rate of loss by seepage, per cent of flow per mile.
Q = flow in canal in cubic feet per second.
v = value of 1 cu. ft. per second per annum.
p = length of perimeter to be lined, in feet.
i = rate of interest, depreciation and renewal.
c = cost of lining in place per cubic yard.

By transposing the terms the rate of seepage which will justify a given thickness t is $s = \frac{16.3\ ptci}{Qv}$



Semi-Circular Section.

With the increasing price of water and with the development of water by storage and pumping, which is almost always expensive, the time will soon come when many of our irrigation canals will be concrete lined.

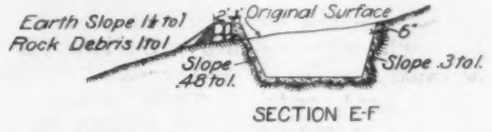
Change of Canal, Cross Sections or Junction of Canals With Flumes, Tunnels, Etc.

In irrigation work it is often necessary to change the cross section of canals and to increase or decrease the velocity. The following cases often occur:

1st. To pass from one material to another which will stand a higher velocity.
2nd. To pass from an unlined section to a lined section.
3rd. To pass from a canal to a flume, tunnel, culvert, etc.

The transition can be made by introducing the proper difference in elevation to change the velocity and by changing the section by one of the following manners:

1st. By maintaining a constant side slope, using for the transition either the side slope of the lined section or the side slope of the earth canal or an intermediate side slope.
2nd. By warping the surface, which is usually the preferable method if not too difficult to construct.
3rd. By vertical wings placed on an acute angle to direction of flow.



Intermediate Change in Section.

For these problems the following formula is developed:

Let
H_1 = total fall necessary to gain the required increased velocity and to overcome the friction and impact in the transition.
h_v = velocity head to gain increased velocity.
h_f = friction head.
h_i = loss of head due to impact.
s = grade of transition.
l = length of transition.
v_1 = velocity at upper end of transition.
v_2 = velocity at lower end of transition.

To simplify the problem the following approximation is made: Assume that the velocity changes uniformly from v_1 to v_2; use an average hydraulic radius for the transition which will be the hydraulic radius of the middle section of the transition and assume for the average Kutter's coefficient of the transition the coefficient obtained for the middle section for the grade S.

H_2 = gain in elevation obtained at the outlet when passing from a higher velocity to a lower velocity.

$v_m = \frac{v_1 + v_2}{2}$ = mean velocity of transition.

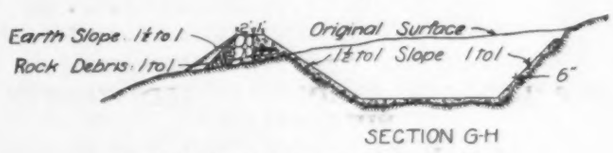
C_m = mean Kutter's coefficient for transition.
r_m = hydraulic radius of section at middle of transition.

$$h_v = \frac{(v_2)^2}{2g} - \frac{(v_1)^2}{2g};\quad v_m = C_m\sqrt{r_m s};\quad \text{but } s = \frac{h_f}{l}$$

Therefore

$$v_m = C_m\sqrt{\frac{h_f}{r_m l}};\quad h_f = \frac{(v_m)^2 l}{(C_m)^2 r_m}$$

In addition to the velocity head and friction there is more or less loss of head due to impact. This loss of head due to impact may be expressed by an equation of the folowing form: $h_i = c\left(\frac{(v_2)^2 - (v_1)^2}{2g}\right)$, where c is a co-efficient which will depend on the length and form of the transition; it will probably not exceed .25 and may be considerably less for a good transition; .25 may be taken as a safe value.



Final Change From Tunnel to Ditch.

The total fall necessary at the inlet is then:

$$H_1 = h_v + h_f + h_i = \frac{(v_2)^2 - (v_1)^2}{2g} + \frac{(v_m)^2 l}{(C_m)^2 r_m} + .25\,\frac{(V_2)^2 - (V_1)^2}{2g}$$

or

$$H_1 = 1.25\frac{(v_2)^2-(v_1)^2}{2_g}+\frac{(v_m)^2 l}{(C_m)^2 r_m}$$

The gain in elevation obtained at the outlet is then:

$$H_2 = h_v - h_f - h_1 = \frac{(v_2)^2-(v_1)^2}{2_g} - \frac{(v_m)^2 l}{(C_m)^2 r_m} - .25\frac{(v_2)^2-(v_1)^2}{2_g}$$

On the Umatilla project in Oregon gaugings were made in a semi-circular concrete lined conduit and the following results were obtained in the inlet transition from the canal in earth to the concrete lined section. The concrete lined conduit is 9.8 ft. in diameter and has a maximum carrying capacity of about 300 second ft. The earth canal has a bottom width of 17.4 ft., a depth of 7.5 ft. and side slopes of 1 :1 on one side, and 1½ : 1 on the other. The transition consists of warped surfaces 25 ft. long. The concrete lined channel has a total length of 2.085 ft. and a number of sharp curves including a double reverse curve with 100 ft., 50 ft. and 50 ft. radius. When the gauging was made the volume carried was 205 second ft. and considering the channel as a whole the mean depth of water was 3.95 ft., mean area of the water cross section 28.47 sq. ft., the hydraulic radius 2:11 ft., the velocity 7.20 ft. per second and n = .0146. The earth section had a depth of water of 4.3 ft. and a velocity of 2 ft. With this data the computations for the transition are:

$$H_1 = 1.25\frac{(7.20)^2-(2.0)^2}{64.4}+\frac{(v_m)^2 l}{(C_m)^2 r_m};\ \text{but } v_m = \frac{7.20+2.0}{2} = 4.6$$

$$l = 25;\ C_m = \frac{117+77}{2} = 97;\ r_m = \frac{2.11+3.13}{2} = 2.62$$

$$A_1 = 1.25\frac{(7.20)^2-(2.0)^2}{64.4}+\frac{(4.6)^2\times 25}{(97)^2\times 2.62} = .93+.0213 = .9513 \text{ ft.}$$

The loss of head actually measured was .95 ft. which checks very closely with the above computations. The loss of head due to friction in the transition itself is very small and practically negligible in any case. The loss of head due to impact is considerable, amounting in this case to about $.25\frac{(v_2)^2-(v_1)^2}{2_g}$ or .185 ft. This shows the necessity for using longer transitions where the loss of head is a detriment. A transition of sufficient length to give an increase or decrease in average width of canal section of 3 ft. for every 10 ft. in length would probably decrease the coefficient of impact to about .15.

WIRELESS TELEPHONE HEARD THIRTY-FIVE MILES.

Assistant Professor G. W. Pierce, of Harvard, in co-operation with John Hays Hammond Jr., the well-known inventive scientist, conducted a series of experiments by wireless telephone at the latter's laboratory at Gloucester, recently, with excellent results. The two experimenters got into communication with the Harvaard Wireless Club and talked with its members for fully fifteen minutes. Cambridge and Gloucester are thirty-five miles apart and this makes the experiment all the more wonderful.

SYNOPSIS OF PROPOSED WORKMEN'S COMPENSATION LAW IN OREGON.

The members of the Oregon Commission were selected with the view that they would be fairly representative of the various interests of the state to be affected by the enactment of legislation of the character proposed. Three of the number are representatives of labor, three representatives of employers of labor, and three representing the taxpayers of the state.

The law which has been drafted covers substantially the same occupations as are affected by the Washington act.

The State of New York passed a compulsory act and its court of last resort, the Court of Appeals, unanimously held the act unconstitutional, both under the state constitution and the constitution of the United States. On the other hand, the Supreme Court of Washington sustained an act substantially identical, so far as constitutional objections were concerned, with the New York act.

No question of constitutionality can be seriously raised against an act which is elective in character, therefore the proposed enactment of a law is elective and not compulsory. All of the states other than New York and Washington which have adopted legislation of this character have enacted elective laws, and their constitutionality has been sustained in every instance.

So far as the employer is concerned, the act will doubtless be uniformly accepted, since it provides that in case the employer refuses to accept its terms he shall not be permitted to plead as a defense in any action brought by his injured workman that the injury was the result of contributory negligence, the negligence of a fellow servant, or that the injured person assumed the risk which resulted in his injury.

On the other hand, though the workman is entitled if he so desires, to reject the benefits of the act, its advantages to him are so certain and so obvious that his acceptance of its terms is practically assured.

The election by both the employer and the workman is required at the time the act becomes operative, or at the time the employment commences, and no election can be exercised after the happening of an accident. The act, if adopted, will become operative on July 1, 1913, and will affect all employers engaged in the hazardous occupations who do not affirmatively elect not to work under it at least fifteen days before that date and all workmen of such employers who do not affirmativeuy reject it before that date.

By mutual agreement between employers and workmen engaged in occupations other than those specially defined, the act may be made applicable to them.

The law proposed contemplates the creation of a State Industrial Commission composed of three members and charged with the administration of the act. This industrial commission receives the money payable under the act and deposits it with the state treasurer. Whenever a claim is allowed on account of death or such disability as entitles the claimant to receive an allowance by way of monthly installments for a period of two years or more, it becomes the duty of the state treasurer to set apart a sum sufficient in view of the life expectancy of the claimant, if the installments are to continue for life, or for the period fixed by the act,

if the allowance be for an injury, as will meet the monthly installments thereafter to fall due. Such funds so set apart are required to be invested in securities of the class authorized for the investment of funds by savings banks under the laws of this state, thus absolutely guaranteeing the payment of the installments.

The act contains a schedule of allowances for death, total permanent disability and various permanent partial disabilities, and invests the commission with authority to fix by reference to those specified the allowances for such partial disabilities the precise nature or extent of which it is impossible to foresee or to define.

The findings of the commission are made final on all questions of fact, the only right of review preserved being on questions of law involving a construction of the act.

An exception is made with respect to the payment of allowances in monthly installments to this extent: The commission is invested with authority in its discretion to pay over to a beneficiary who is or becomes a non-resident of the state a lump sum equal to three-fourths of the present value of future installments, and also to a resident beneficiary a sum not greater than one-fourth of the present value of future installments. In the first case mentioned the claim of the non-resident beneficiary is thereby extinguished, and in the second all subsequent monthly installments are proportionately reduced. The object of the first provision is to relieve the state of the expense of administration for the benefit of those in which it is not directly interested, and the object of the second provision is to make possible the exercise of a wise discretion by the commission where a substantial sum presently available may be useful in lifting an incumbrance from a home or establishing a beneficiary in some business which may aid in his support.

Under the Washington law in the event of a fatal accident to her husband, a widow receives until death or remarriage twenty dollars a month and an additional sum of $5 for each child under the age of 16 years, but in no event more than $35. By the proposed Oregon law a widow receives $25 a month and $6 for each child under 16, with a maximum allowance of $45.

Under the Washington law the maximum allowance for a permanent partial disability is a lump sum payment of $1500 for the loss of a right arm at or above the elbow. By the proposed Oregon law a person suffering this injury is entitled to $25 a month for 96 months (eight years). The present value of such a series of payments computed at 4 per cent is $2015.

The bill proposed also contains a feature of the most importance and which is not contained in the Washington act, namely, a provision for first aid and surgical treatment, and hospital accommodations. This provision authorizes the commission at an expense not greater than $250 in any one case to provide such first aid, together with transportation, medical and surgical attendance and hospital accommodations, and also authorizes the commission in its discretion to permit employers upon terms fixed by it and under its supervision to make such provision. It is believed that under this authority much suffering can be relieved and many lives saved.

The act provides that each employer subject to its terms shall each month retain from the wages of his workmen a sum equal to five-tenths of 1 per cent of such wages, and shall pay the amount so retained with his own contribution in a sum equal to six times such amount, or 3 per cent of his monthly payroll. To this amount shall be added by the state a sum equal to the amount contributed by the workmen. Such payments shall continue until the employer shall have contributed to the fund an amount equal to 3 per cent of his annual payroll computed by taking twelve times his current monthly payroll. If no accidents have occurred in his business, both he and his employes are then relieved from further payments, provided there are sufficient moneys in the fund to meet all demands upon it. Whenever payments are made from the fund on account of such employer's workmen his obligation to continue payments is revived until he once more reaches the point where his contributions, less payments for account of his men, equal the required 3 per cent of his annual payroll.

It is believed that this provision will work even-handed justice to all employers, whatever the comparative hazard of their business, and will place a premium on individual care which can be secured in no other way.

Provision is made for the prompt payment of the moneys due from the employer by denying him the benefits of the act for default in payment after demand. In such a case the injured workman has the option of suing his employer or of taking under the act, and if he elects to take under the act, the commission succeeds to the right of action against the employer, which the workman might have maintained.

In the interest of the workmen and the state it has been thought wise to preserve the effect of the statutory requirements with respect to maintaining safety appliances and devices. Therefore, the act provides that, if the commission shall determine that an injury has been caused by an employer's violation of the law in this regard, he shall be subject to suit at the election of the injured workman, unless such workman shall take under the act.

In order to insure to the full extent the purposes sought to be accomplished, the bill contains a provision exempting all moneys paid or payable under its terms from seizure for any debt of the beneficiary.

OREGON AGRICULTURAL COLLEGE USES ELECTRICAL APPLIANCES.

Manager Morton of the Oregon Power Company, Albany, Oregon, in his Weekly Letter of December 10th, says: "We are taking on some interesting business in the appliance line at the Oregon Agricultural College. In the agronomy department they are using a toaster stove for the baking of soils; in the bacteriological department they are using electricity for heating for germ incubation. We are also placing a flat square stove for other work. In the chemistry department we are working out some electric heating and in the poultry department they use electricity for electric incubators. This work is being done in connection with the electrical engineering department of the college. There is a very large field at the college for this business."

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New Agriculture and the Engineer

Victor Hugo truly said "Happy is the nation that has no annals." To apply this statment to a modern technical journal one should substitute "editor" for "nation" and "typographical errors" for "annals." This editorial was in last week's issue left most unfortunately suspended in midair. We conclude in the following lines the probable future relationship of the engineer and the new agriculture:

The immediate duty of the agriculturist under the proposed regime is, through research and education, to make the agriculture of California more prosperous. Through its various divisions, it must strain every nerve to solve the material problems, which beset those who create wealth from the soil. Picture the countless new industries that must, perforce, be brought to light. Dr. Eyde of Norway, a recent visitor to California, alone would demand 150,000 horsepower should be install his plant for the Birkelund-Eyde process of producing synthetic nitrogen fertilizers for the soil. Again, recent investigation emphasizes the fact that water can be lifted electrically, fifty feet vertical, cheaper than it can be made to flow by gravity through a canal five miles or over in length. Here, then, is a possible application of electrical power wherein many gravity installations may be abandoned due to the ingenuity of the electrical engineer. It takes little further imagination to picture the countless related engineering investigations that will inevitably follow. "Back-to-the-farm," then, must be the new call of the engineer, and he who would interpret the true meaning of this call, will do well to follow with his future investigations and activities largely in the wake of the agriculturist.

Proposed Power and Water Supply for San Francisco

When a city proposes to appropriate 400,000,000 gallons of water daily, or in other words, divert, 445,000 acre ft. of water annually from any particlar water-shed, the entire commonwealth wherein this city is located, may well be concerned in the computations involved. The most recent report of the U. S. Geological Survey on the waters of California states that a total of 11,500,000 acre ft. is the average total drainage from the San Joaquin waters and that since 3,000,000 acre ft. are lost in the Tulare sink, only 8,500,000 acre ft. actually drain off toward San Francisco. In this self-same area is located over 7,000,000 acres of possible irrigable land. On the other hand, in the great Sacramento district to the north an average drainage of 20,000,000 acre ft. prevails and a total of 2,250,000 possible acres of irrigable lands are to be found. Hence at first sight it is seen that the San Joaquin Valley has not sufficient water at best for its ultimate development, while the Sacramento Valley drainage has more than ample to supply all possible needs.

If there is another possible source of water supply which computed upon a basis of discounted present value is comparable in cost, and quantity and quality of supply to the Hetch-Hetchy scheme, and if the Hetch-Hetchy scheme is found, from impartial investigation, to be a possible undue drain upon the Tuolumne basin, then by all means the city of San Francisco should turn in that direction regardless of the

former heavy expenditures. For it is not good business policy in a great commonwealth blessed in natural agricultural possibilities to allow a gigantic water scheme to waste its natural reclamation possibilities.

The investigation at Washington has brought out some facts worthy of further consideration. It developed at this hearing that the consulting engineer's estimates of costs upon the Hetch-Hetchy plan were computed upon a basis of labor at $2.25 per day and freight rates to be charged passing through the Panama Canal, while those of Consulting Engineer Hazen in estimating the filtering of the Sacramento waters were on a $3.10 per day basis and the freight charges those at present in force. The Secretary of the Interior has ordered a harmonizing of these computations in order to arrive at a basis of comparison.

Even on this revised basis of comparison, however, a just measure of actual cost differences can not be made. The only possible fair method would be on the basis of discounted "present value" of the different projects proposed. For instance, curves should be drawn showing a relationship, during the coming century, of estimated population and use of water at the varying periods. Interest, taxes, operating expenses and depreciation should all be proportionately taken care of. From such a curve, then, could be derived the actual average cost per annum for San Francisco. A system such as the Sacramento River filtering scheme which may be economically added to from time to time, as the needs arise, would appear in its true prospective by discounting the present value of a scheme such as the Hetch-Hetchy or the Indian Reservoir on the Feather River which must needs be almost completely developed from the start, although San Francisco will not need such vast waters for years to come. This proposed problem of discounting the present value may be tedious in solution. Any proposition, however, of such financial magnitude and which may disturb the irrigation balance in a great commonwealth, is indeed worthy of the greatest care in solution.

The Justification of Workmen's Compensation

The proposed Oregon law on workmen's compensation, briefed elsewhere in this issue, together with the agitation now on in California looking to a revision of the Rosebury law, naturally suggests a timely discussion as to the real justification of workmen's compensation, if at all.

The common law has, since time immemoriam, recognized four fundamental points upon which the master or employer is responsible for damages. First, an injury caused through the wrongful act, neglect or default of himself, foreman or superintendent. He may be held, too, when an injury results from machinery out of repair or unsuited for the use to which it may be put. Failure to provide safe appliances is the third grounds, and, in the fourth place proper warning or instruction not being given, makes the employer liable. On the other hand, the three points upon which damages can not be collected are when an injury is caused by a fellow employe of the injured by the contributing carelessness of the injured party, or from any injury arising out of the usual hazard recognized in the industry.

To view this matter in a manner free from passion, divorced from all partisan spirit, we must for the moment note the bleeding cry that has arisen in the land since the advent of the modern industrial era. Common law found its origin in days when the subtle high voltage wires, the seething molten pot of iron, the crushing burdens of the giant travelling crane, the treacheries of whirring machinery, and a thousand other possible human tortures, not recorded in Dante's Inferno, were totally unknown quantities. To meet the growing demands of society, invention has brought forth a wonderful, new creation—a creation, however, beset with countless pitfalls and dangers. These dangers are so subtle and man so bedazzled with the new order of things, so unaccustomed to handle them to charge the injury to the cost of the industry is but just and reasonable. To say that a commonwealth so protecting its citizens is at a disadvantage in the sale of its products may be a true statement of conditions, but can anyone familiar with the human suffering involved countenance the unjust proportion of life's burden, which the present system necessitates? No. Let us throw the burden of industrial loss on each branch of industry. It will then become an overhead charge against the production of that industry to be eventually borne by society, that master whom all industry serves.

Under such a scheme of compensation we must, however, be cautious, or we may err on the other side of equi-balanced justice. The employer of today spends his thousands for protective equipment, for beautiful grounds, for flowers and receives in return a higher human service. In all industries, known to be hazardous, a higher remuneration is as a rule paid the employe. The hairless chinamen of the New Almaden quicksilver mines, the workers in the giant powder works, and the high salaried aviators of the day, all bear testimony to this fact. While in any event a somewhat higher wage should be paid to the employe as a honorarium against possible human suffering, which no compensation can truly meet, still the proportion of moneys to be paid by the wage-earners and by the employer in the creating of compensation funds is one that merits the most careful consideration. It is clearly unfair to pay the employe a wage befitting a hazardous profession and then, too, demand that the industry care for him or his dependents in event of casualty. The Oregon commission proposes that the employer contribute 6 units, the employe 1 unit and the state 1 unit as a basis of assessment for such funds. Under any scheme, a definite basis of liability must be settled upon, in order that the present curse —litigation—be avoided

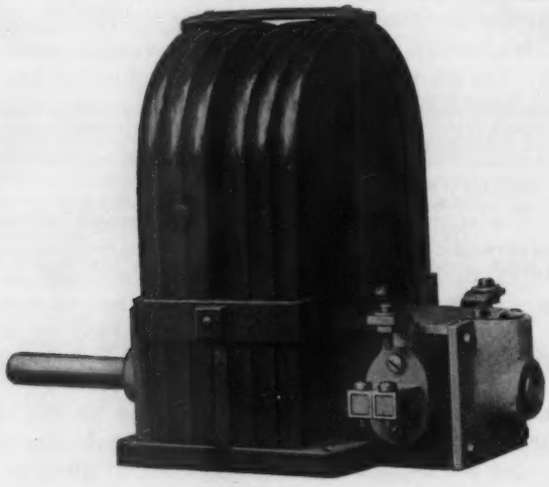
It would seem, too, that although the fundamental reason for accumulating compensation funds is to aid the sick, the dying and their dependents, there should be a reward for care in the avoidance of accidents. To this extent the Oregon law is truly commendable in providing an automatic stoppage of assessments when the protecting larder becomes full to overflowing, due to care and caution on the part of employer and employe. This charging and discharging illustrative of storage battery action, is indeed a happy suggestion to reduce the bleeding casualties of the industries to a minimum.

INDUSTRIAL

ELECTRIC SPEED INDICATOR.

The desirability of knowing the speed of vehicle, machinery, or shafting at any time is something that is now so generally required in every branch of industrial work that a variety of instruments for this purpose have been brought out from time to time. The use, however, of the majority of these indicators is limited to a particular class of apparatus and hence not practicable for use on different applications. For such a universal application the electric indicator, illustrated herewith, is especially adapted.

The electric speed indicator consists of a magneto-generator and a direct current measuring instrument. The magneto is attached to a pulley or shaft of the apparatus the speed of which is to be measured and since the voltage of the magneto-generator is proportional to its speed, the meter, which is properly calibrated, indicates the speed directly at any time. When operating at 1000 revolutions per minute, the magneto generates 25 volts, so that the meter may be calibrated for any unit, as revolutions per minute, cycles per second, percentages fast or slow, or feet per minute.



Electric Speed Indicator.

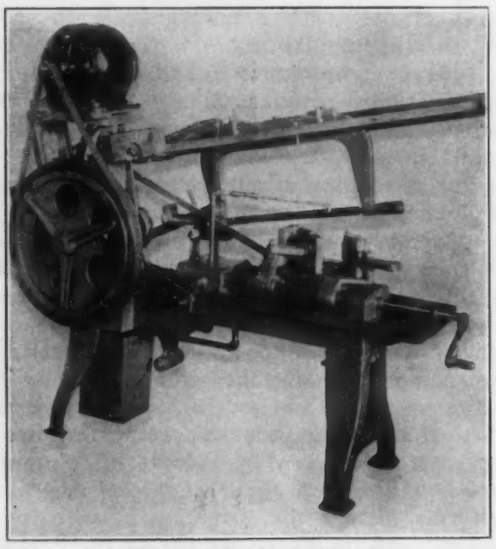
On account of the ease with which these indicators may be adapted to the many types of machinery, they find a wide field of application. The meter may be mounted some little distance from the indicator so that it is possible to place a number of the meters in one place, making it possible for those in charge to note the efficiency of the work in the various departments at any time. In connection with newspaper presses, the application is to note the number of copies being printed at any time or the total number of an edition.

The ability to have a complete record of the operation of the machine is made possible by the use of a graphic meter in connection with the magneto. This use will prove especially beneficial where a test of efficiency of a piece of apparatus is desired. For railway trains, such a meter is a good indicator as to whether or not instructions have been carried out regarding the speed along the line. The large number of railroad wrecks that have occurred within recent years due to failure to comply with speed orders has brought the need of such a device more prominently to the notice of railroad officials.

The indicator is small and can be placed anywhere near the machine, the over-all dimensions being only 6 x 10 x 10 inches and a variety of meters may be used with it. The magneto-generator, which is manufactured by the Holtzer-Cabot Electric Company, is especially designed for use with meters manufactured by the Westinghouse Electric & Manufacturing Company.

NEW HIGH-SPEED HACK SAW, ELECTRICALLY DRIVEN.

A high-speed hack saw, in which the length of the stroke is automatically regulated by the size of the stock held in the vise, is one of the latest devices to which Crocker-Wheeler electric drive has been applied. This metal-cutting machine, the No. 7 Kwik Kut, manufactured by E. C. Atkins & Co. of Indianapolis, Ind., is so constructed that practically the entire blade is utilized at each stroke, regardless of the size of stock, and without attention or changing the machine by hand. This is a distinct advance over the standard length of stroke of about six inches, adopted for most machines in which the length of the stroke can be changed only by hand.



High-Speed Hack Saw.

The cutting capacity of a power hack saw machine is determined by the travel of the blade and the weight of the saw arm. The gain due to the full stroke of the blade automatically obtained in this machine varies from at least 25 per cent on the largest sizes to 100 per cent on the smaller sizes. This also results in a great saving in the use of blades, as the wear on them is distributed over a greater area. The saving in the use of blades is further increased by employing a simple device, by means of which the blade is slightly raised on the return (non-cutting) stroke.

IMPROVED TYPE PORTABLE RAILWAY TELEPHONE.

A new and compact feature has been added to the Kellogg portable telephone, which increases its value in railway service, in the placing of the spool beneath the instrument proper. With this arrangement for winding up the cord the set is made much more compact, and at the same time gives room for plenty of cord.

These instruments are uesd exclusively on one well-known line by linemen, trainmen and officials along the line, and are being permanently installed on many other railroads in the United States.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Sam Van Ornum, city engineer of Pasadena, is a recent San Francisco visitor.

W. S. Heger has taken up the Pacific Coast representation of Edge Moor Iron Company water tube boilers.

Frank E. Watts, 11th Jupiter of the Jovian Order, expects to make a trip to the Pacific Coast early in 1913 and will be in San Francisco on February 3, 4, 5 and 6.

R. S. Buck of the firm of Sanderson & Porter left this week for New York City. **Wynn Meredith** will leave on January 2. Both will attend the annual meeting of the firm in New York City.

J. P. Zipf, formerly with R. F. Chevalier, consulting engineer, is now engineer for the Ramie Fibre Company of San Francisco. The company is at present engaged in erecting a factory for its fibre products in Oakland, Cal.

H. A. Lardner, Pacific Coast manager of J. G. White & Co., went over the lines of the Oakland & Antioch Railway this week. There is less than 300 feet of tunnel to be driven to complete the connection and this will be done by the end of January, 1913.

C. O. Poole, of Manifold & Poole, consulting engineers of Los Angeles, has recently been operated upon for appendicitis, which made its appearance in a most ugly type. He is now greatly improved and doctors have every confidence for his ultimate recovery

W. W. Briggs, assistant sales manager of the Westinghouse Electric & Manufacturing Company, is receiving congratulations upon his successful efforts in bringing about a gift of $10,000 worth of electrical apparatus from his company to the Panama-Pacific Company.

Walter Clark, electrical engineer of the Victoria Falls & Transvaal Power Company of South Africa, which furnishes power for the big mines of Rand, is at the St. Francis. Clark returned recently from a visit to Alaska, whose mining development greatly interested him.

L. E. Robertson, formerly of the Suburban & Eastern Railroad, with headquarters in Oakland, will succeed H. A. Mitchell as general manager of the Central California Traction Company after the first of the year. Mr Mitchell will assume the position of general manager of the Oakland, Antioch and Eastern Railroad. He will have his headquarters in Stockton.

Sidney R. Inch, retiring general manager of the Missoula Light & Power Company of Missoula, Montana, was given a farewell spread on December 21st by the employees of the company, as stated two weeks ago in these columns. Mr. Inch assumes his new duties at Salt Lake City as general superintendent of the Utah Light and Power Company on New Year's Day.

Charles C. Moore, president of the Panama-Pacific Exposition Company, announces that he will build for Charles C. Moore & Co. a six-story building on the northeast corner of First and Mission streets, purchased a few days ago at auction in the office of A. J. Rich & Co. from Baroness Von Schroder. The building will be erected exclusively for the firm and its engineers, and will be class A. Plans are being prepared and building will commence at once.

H. V. Carter and **W. L Goodwin,** who have been so earnestly engaged for the past month or more with the many details incident to removal of the Pacific States Electric Company to their new home, 575 Mission street, San Francisco, had the satisfaction of seeing their efforts crowned with success. The new quarters were occupied December 23, the date previously set, and it was indeed pleasing to note the spirit of co-operation that prevailed among the entire staff of employees in attaining this result. A formal opening was held in the evening from 7:30 to 10 o'clock, during which time more than a thousand guests were entertained.

LUNCHEON TO JOVIANS AT SEATTLE.

One hundred and twenty-five electrical contractors, dealers, supply men, manufacturers' agents and manufacturers themselves sat down to an electrically prepared lunch November 21, at 1:30, the guests of the Electric Company and the Northwestern Supply Company, complimentary to the Sons of Jove, and others engaged in the business of generating electricity, selling the marketable product and encouraging the use of the current.

Following the luncheon short talks were made by the chairman of the day, Burton R. Stare, of the Northwestern Supply Company; P. J. Aaron, manager of the Western Elec tric Company; Charles M. Bliven, of the General Elec tric Company; H. N. Kollock, manager of the Seattle branch of the Westinghouse Company; W. J. Grambs, Superintendent Light and Power, P. S. T., L. & P. Company; Morton Ramsdell, sales manager; James D Ross, superintendent of the city lighting plant; G. I. Kinney, manager of the San Francisco office of the Fort Wayne Electric Company.

The menu distinctive as to the names of dishes, was prepared by Mrs. Elinor M. Redington, demonstrator, who is carrying on a series of lectures and a cooking school for the Puget Sound Traction, Light & Power Company, proselyting the use of electricity for cooking and miscellaneous uses in connection with domestic science. The spread was voted a complete success and enthusiastic endorsement was given to the types of stoves used in preparing the meal, the following being the bill of fare:

Westinghouse Celery. General Electric Olives.
W. E. Co. Cream of Tomato. U. S. Steel Crackers.
Roebling Sweet Pickles.
Roast Turkey, a la Hughes Kendrick, Cranberry Sauce.
Baked Ham, a la Copeman.
Fobes Sweet Potatoes, Southern Style.
Prime Roast Beef, a la Simplex.
Pacific States Sweet Potatoes. Johns-Manville Vittucci Salad.
Holabird "Hot Point" Bread.
Globe June Peas.
Reardon Pineapple Souffle. Gleason Crisco Cake.
Cascade Crescent Cream Coffee. Lushington Mints.
Pacific Lamp Cigarettes. Northwestern Cigars.

OREGON SOCIETY OF ENGINEERS.

John T. Whistler spoke Thursday evening, December 19th, to the members of the Oregon Society of Engineers, at Portland on the general subject of water resources of Oregon. In a presentation of well selected facts involving dormant water resources and the mineral constituents and the feasibility of their utilization, Mr. Whistler clearly showed the enormity of their magnitude. Attention was called to the need of state aid in their development. Principles laid down as fundamental law by commissions of other states were cited as worthy of adoption by the Water Board of Oregon.

Mr. Eugene Brookings, President of the Progressive Business Men's Club, by invitation, spoke upon club work and its attendant results. He strongly urged the intermingling of all organized men in a social way to the end that united energies might be directed toward the accomplishment of those public measures which make for common good.

SAN FRANCISCO ENGINEERS' CLUB.

On account of the holidays the regular weekly luncheons of the Engineers' Club, December 24 and 31, was not held. Tuesday, January 7th, Mr. George Nolan, manager for the Dow Willans Diesel Engine Company, will be the guest of the club and will be prepared to answer questions regarding Diesel engines.

OREGON ELECTRICAL CONTRACTORS' CONVENTION AND JOVIAN MEETING, PORTLAND, OREGON.

This week has been an exceedingly busy one for the Electrical Contractors, as well as all other electrical men in Oregon. The convention was a great success, and its effect will be to unify all electrical interests in Oregon.

On the opening day there were 125 registered at this convention. The papers were exceptionally good and called forth a great deal of discussion.

At 12 o'clock a "buffet" lunch was served in the convention hall, after which the paper reading was resumed. The papers presented were as follows: F. D. Weber, inspector for the Underwriters' Equitable Rating Bureau, read a paper on "The Relations of the Oregon Electrical Contractor to the Underwriter's Inspection Work in Oregon"; F. N. Averill, manager of the Fobes Supply Company, discussed "The Relation of the Electrical Jobber to the Electrical Contractor"; George H. Duffield, special representative of the N. E. C. A., spoke on "What the National Electrical Contractors' Association Is Doing for Electrical Contractors"; O. B. Coldwell made "Some Pratical Statements from a Central Station Expert"; Howard Joslyn, city electrician of Seattle, spoke on "Municipal Inspection"; "Credit—Its Utility in the Modern Commercial World," was the subject of L. B. Smith, and Cost and Efficiency" was discussed by P. L. Proctor, manager of the Pacific Audit Company.

In the evening the contractors, their guests and ladies attended the Orpheum theater, where the actors endeavored to air all their knowledge of electricity and electrical terms to the amusement of a great portion of the audience.

On Wednesday, two special cars took all those desiring to visit the River Mill Plant of the P. R., L. & P. Company's at River Mill, and thence back to Estracada, where a chicken dinner was served. During the dinner Mr. J. E. Werlein, of the P. R., L. & P. Company, kept the "ball rolling" as toastmaster. The day was made complete by having the "Little German Band" along, known locally as the "Hungry Seven."

After returning from this trip the members assembled in the Electric Building and elected officers for the ensuing year. The following officers were elected: Guy Littler, president; H. D. Lockore, first vice-president; W. H. Baker, second vice-president; J. L. Vaughan, third vice-president; L. E. Dawson, fourth vice-president; F. C. Green, secretary; J. R. Tomilson, treasurer.

Wednesday evening a most sumptuous banquet was partaken of at the Multnomah Hotel, there being 110 plates served.

The Jovian luncheon, Thursday was not forgotten and the place was filled to its capacity. Mr. B. L. Josselyn, president of the Portland Railway, Light & Power Company, was the speaker of the day. His speech was very appropriate and voiced the sentiments of the Jovian Order in strong terms.

At 8 p. m. a Rejuvenation was held at the Multnomah Hotel, where 46 candidates were given the honors. This ended a most glorious convention.

NEW BOOKLET ON STORAGE BATTERY OPERATION.

One of the best indications of the simplicity and ease of operation of the electric vehicle when equipped with a dependable battery, is shown in a small book of only six pages just issued by The Electric Storage Battery Company of Philadelphia. It is entitled "Instruction Book for the Operation of "Exide Vehicle Batteries," and gives a remarkably few words all the necessary information which the owner of an "Electric" need possess to keep his battery in good working order. Those who have hitherto imagined the vehicle battery to be a complicated and troublesome piece of apparatus to maintain, should send for a copy of this booklet which covers the instructions for the "Ironclad-Exide," "Exide," "Hycap-Exide" and Thin-Exide" Batteries.

NOTES OF THE CALIFORNIA RAILROAD COMMISSION.

Dec. 11.

A decision was rendered granting permission to the Sierra & San Francisco Power Company to purchase the Gold Mountain Water Company, of Sonora, Tuolumne County, for $27,500.

A decision was rendered establishing rates for the Hawthorne Electric & Water Company, operating in Los Angeles County.

L. W. Warmoth was granted permission to sell his tele phone system in Tehama and Glenn Counties to the Pacific Telephone & Telegraph Company for $4500.

Applications for grade crossings were granted as follows: Pacific Electric Railway Company to cross the South ern Pacific near Raymer, Los Angeles County; Southern Pacific to build a spur track across Elm and Sycamore streets Red Bluff; County of Tulare to construct three public highways over the Southern Pacific near Terra Bella, Tulare County; Southern Pacific to construct a spur track across K street, Fresno; Southern Pacific to construct a sidetrack across Chapman street, in McPherson, Los Angeles County.

A decision was rendered granting the application of the San Francisco-Oakland Terminal Railways for a certificate of public convenience and necessity to exercise franchise rights in Berkeley for the operation of a street railway on Eunice street.

The Commission adopted an annual report form to be used by all electric, gas, water and telephone companies.

Dec. 16.

The city of Palo Alto, after voting the control of its utilties to the Railroad Commission, complained against the rates of the Palo Alto Gas & Electric Company. The defendant applied to the Superior Court of Santa Clara County for a writ of prohibition to prevent the Commission from proceeding to hear the case, contending that the city trustees of Palo Alto had already fixed the rate for the ensuing year and that the Railroad Commission could not act until the end of that year. The decision of the Superior Court sustained the Railroad Commission, enabling it to proceed with the hearing.

Dec. 17.

The Haywards Chamber of Commerce filed a complaint against the San Francisco-Oakland Terminal Railways, charging excessive and irregular rates between Oakland and points as far as Hayward.

Herman G. Walker filed a complaint against the San Francisco-Oakland Terminal Railways, charging that illegal conditions had been inserted in the commutation book contract issued for transportation between San Leandro and Hayward. He asked that these conditions be corrected, that the company be compelled to permit public inspecton of its schedules of fares, and that it cease charging 15 cents fare between Hayward and San Leandro.

Application was filed by the San Francisco-Oakland Terminal Railways, asking for permission to increase the rate between San Leandro and Hayward from 10 to 15 cents. The company has collected 15 cents instead of the published rate of 10 cents, which it asserts was a clerical error.

Dec. 18.

The Commission decided to conduct a series of tests in the Induction Cases, in which the Pacific Telephone & Telegraph Company complained of serious interference with the operation of its telephone lines by induction from high tension power lines in proximity to its wires.

Dec. 19.

Application was filed by the Coast Counties Gas & Electric Company for permission to purchase the Gilroy Gas Works for $25,000 and such additions thereto as were made with the city of Gilroy.

NEWS NOTES

INCORPORATIONS.

RIVERSIDE, CAL.—Articles of incorporation have been filed of the Superior Mutual Water Company, which will have its principal place of business in Riverside, and serve water users in Elsinore. Capital stock is $500,000; directors are Charles P. Waite, P. D. Castlemen, Charles Johnson, D. Harvery, W. S. Durkin.

DOVER, DEL.—The California Railway & Power Company has been chartered with a capital of $60,000,000. The purpose of the company, as indicated by the articles of incorporation, is to take over the United Railroads of San Francisco, the Sierra & San Francisco Power Company, the Coast Valleys Gas & Electric Company and the San Francnsco Electric Railways. The concern will maintain offices in New York and San Francisco.

ILLUMINATION.

OGDEN, UTAH.—The board of city commissioners have passed an ordinance grantng a 40-year franchise for the operation of a gas system in the city to C. A. Boyd.

WATTS, CAL.—Bids will be received up to January 28th, for a franchise to lay and construct a gas pipe system along the public streets and alleys described in the franchise.

ARTESIA, N. M.—The Artesia Light & Power Company have applied for a franchise to install a system of gas works. An election will be held December 28 to decide whether it shall be granted.

NEW WESTMINSTER, B. C.—The city council is negotiating with the Northern Gas & Power Company of Vancouver, to secure plans and specifications for a plant suitable for this city.

CHANDLER, ARIZ.—Chief Engineer Binkley of the Chandler Improvement Company, has stated that poles have been ordered for electric light lines, the system when completed to cover the entire city.

LOS ANGELES, CAL.—The ornamental lighting scheme of Seventh street, from Los Angeles River bed to Hoover street, has been approved by the city council. This will give three miles of street lights of same class as are now in use on Hill street.

LOS ANGELES, CAL.—In accordance with the recommendation of City Electrician R. H. Manahan, the council will pass an emergency ordinance, providing for the advertisement of bids for the maintenance of 3702 old and 750 new electric arc lights during the following year.

PALO ALTO, CAL.—The Railroad Commission has received word that it has been sustained by the Superior Court in the Palo Alto gas case. The city of Palo Alto, by popular vote, recently transferred the control of its utilities to the Railroad Commission, and shortly thereafter complained to the Commission against the rate charged by the Palo Alto Gas & Electric Company. The Palo Alto Gas & Electric Company applied to the Superior Court of Santa Clara County for a writ of prohibition to prevent the Railroad Commission from proceeding to hear the case. The Palo Alto Gas & Electric Company contended that the city trustees of Palo Alto had already fixed the rate for the ensuing year and that the Railroad Commsson could not act until the end of that year. The attorneys for the Commission interposed and have now been sustained by Judge Richards of Santa Clara County. The effect of the decision is to enable the Railroad Commission to proceed with the hearing in the case.

TRANSMISSION.

VANCOUVER, B. C.—A corporation to be known as the Fort Fraser Industrial Corporation, Ltd., backed by some of the most influential men in the province, is to be formed for the express purpose of putting in a big power plant at Fort Fraser.

ELSINORE, CAL.—The Southern Sierras Power Company, through its district Riverside office, has announced the purchase of the Elsinore Electric Light & Power Company, with offices at Elsinore. The new company is under local supervision of District Manager Fred A. Worthley in Riverside. Extensive improvements to the plant are planned, including a new building to house transformers and other necessary apparatus, and the installation of a new pole system.

FRESNO, CAL.—Electricity will soon be transmitted over the new power line from the Coalinga district to San Miguel on the coast, according to a statement by General Manager A. G. Wishon of the San Joaquin Light and Power Company. The new power line will connect the San Joaquin Valley and the Sierra Nevada Mountains with the coast at San Miguel, the power coming from the power plant at Crane Valley. When the "juice" is turned on the county will be ready to supply San Miguel and Paso Robles with power, and the construction of lines beyond those points to furnish power for other coast points is already in progress.

TRANSPORTATION.

ORANGE, CAL.—Bids will be received up to January 8th for a franchise to construct and maintain for fifty years a single or double-track electric railway in certain portions of Orange County in accordance with terms of the franchise.

ORANGE, CAL.—Sealed bids will be received up to January 8th for the franchise applied for granting right to construct and maintain single or double track electric railway in certain portions of Orange, described in said franchise.

RICHMOND, CAL.—Application has been made by the San Francisco, Oakland Terminal Railways for a franchise to construct and operate a railroad for a term of 42 years on McDonald avenue and also in the Canal Subdivision. Sealed bids will be received up to January 13th for the sale of said franchises to the highest bidder.

SAN FRANCISCO, CAL.—The Key Route system, in its plans for so extending its Oakland terminal facilities as to provide a six-track pier from the shore line to the Key Route mole, has made arrangements for maintaining special ferry slips for the use of vessels plying between the mole and North Beach during the 1915 Exposition.

STOCKTON, CAL.—That the Calaveras Copper Company, operating big mines at Copperopolis, plans to build a line connecting its mines with another road leading into Stockton is the statement of Charles M. Hayden of Boston, president of the company. Mr. Hayden was in Stockton not long ago, accompanied by J. H. Trerise, superintendent of the company. Mr. Hayden asserts that the company will decide on one of three surveyed routes, that the road will be sixteen miles long, that it will cost about $200,000, and will be in operation by next August.

MADERA, CAL.—J. S. Harker, president of the Mountain Progressive Club of Coarse Gold, will make an effort to interest the Madera Chamber of Commerce in a project to construct an electric road from Madera to Yosemite Valley. His proposition is to store the waste waters of the North Fork

watershed and utilize them for developing electric power for such a railway. Mr. Harker's object is to employ a competent engineer to make the surveys and gather all the data possible in regards to power, cost of construction, equipment, etc., and place this data before capitalists with a view to interesting them.

SACRAMENTO, CAL.—The Northern Electric Railway, through its subsidiary, the Sacramento & Woodland, has filed a suit with the Railroad Commission against the Southern Pacific to force it to restore a connecting track at Mikon, near Sacramento, and for such other action as the commission might deem proper. The Southern Pacific installed its connecting track in December, 1911, for the transfer of heavy shipments of material used in the construction work on the Northern Electric branch. Although the Northern Electric had remaining about 5000 tons of crushed rock to be delivered at Mikon, the Southern Pacific on November 22 gave notice that on November 29 the connecting track would be discontinued. The complaint alleges a violation of the public utilities act in that thirty days' notice of the proposed change was not given to the Railroad Commission.

SAN FRANCISCO, CAL.—The Supervisors have passed an ordinance granting the United States Railroad Company a revocable permit to extend its tracks from Polk and Bay streets along the latter to the Fort Mason Reservation, connecting with tracks to be laid there. The bill also provided for a section of Laguna street, adjoining the reservation, being used for a loop. The city attorney advised the Supervisors that there is no legal objection to the granting of permission to the United Railroads to abandon the use of the tracks on East street, between Howard and Folsom, and on Folsom, between Steuart and East, a change having been made necessary because of the building of the Belt Railway. The company proposes to route its Folsom street cars to the ferries hereafter by way of East and Howard streets.

SAN FRANCISCO, CAL.—Thornwell Mullally, assistant to the president of the United Railroads says: "The California Railway & Power Company will be operated without debts. Its prior preference stock will be issued under careful restrictions for money for the improvement and extension of the companies it controls. By this method the United Railways Investment Company subordinates its equities in the California properties controlled by it to the fresh money required from time to time in the service of the communities in which the operating companies do business. We will pay on January 1 every bill payable of the United Railroads of San Francisco. We are put in ample funds for future improvements both of the railroad and of the power interests. Without issuing any new bonds or any stock on the United Railroads, that is, without any increased capitalization of that road, we will get cash with which we can and will not only pay off all the debts of the company, but will have ample funds for future improvements."

SAN FRANCISCO, CAL.—Plans for a great railway terminal capable of handling the business of the new Oakland municipal wharves have been completed by the Key Route system. The plans call for the construction of a six-track pier from Oakland's shore line to the Key Route mole, a distance of three and a half miles, at an approximate expense of $2,000,000. They call for the construction of spur and side tracks from the new six-track pier to the district bordering on the municipal wharves, as well as from the present Fourteenth street extension to the municipal wharves, and an enlargement of the present train sheds. The San Francisco, Oakland & San Jose Terminal Railways, the name under which the Key Route properties now operates, will shortly present its plans for an extension of its present rail facilities to the Railroad Commission. So far has the Key Route's plans for the six-track system advanced that the Key Route financiers are already negotiating with contractors for the work of driving the piles. But this is not all. The Key Route backers, convinced that the present mole will be insufficient to adequately handle the traffic they think is bound to accrue, are preparing an extensive enlargement of the present mole facilities. These plans include a greater train shed. They include also a vast extension of the present trackage facilities of the Key Route altogether with the six-track pier system, involving an expenditure of over $7,000,000 before the opening of the 1915 exposition.

TELEPHONE AND TELEGRAPH.

COLFAX, WASH.—The Inland Telegraph & Telephone Company of Spokane has applied for a franchise in Whitman County.

LOS ANGELES, CAL.—The American District Telegraph Company has been granted a franchise to install conduits or string wires in the city streets.

PLACENTIA, CAL.—The Pacific Telephone and Telegraph Company is improving its service in this district by changing its eight-party lines to six-party lines.

SAN DIEGO, CAL.—The Pacific Telephone and Telegraph Company has applied for a permit to construct a three-story brick and concrete exchange building at Seventh and University. The cost is estimated at $30,000.

RIALTO, CAL.—The Pacific Telephone & Telegraph Company has been granted a franchise to erect poles, wires and other appliances for the transmission of electricity for telegraph and telephone purposes along certain streets named in the franchise.

NAPA, CAL.—D. C. Priest has been granted permission to erect poles and suspend wires for a telephone line over a route from the stone bridge near St. Helena thence up Howell Mountain road to the junction of that road with the Chiles Valley and Rutherford roads.

WATERWORKS.

FULLERTON, CAL.—Sealed bids will be received up to December 27th, for furnishing all labor and material for the construction of a municipal water system.

LOS ANGELES, CAL.—A certificate of removal of principal place of business of Elsinore Land & Water Company from Elsinore to Los Angeles has been filed.

EUREKA, CAL.—Three thousand inches of water from the west branch of Willow Creek have been secured by the Bonnieville Mining Company for development purposes.

WICKENBURG, ARIZ.—The Curry waterworks plant, which supplies the Collins and Curry additions and other sections of the town, has been taken over by C. W. Jennings.

REDLANDS, CAL.—Plans and specifications have been completed for a municipal water system, and the commission has recommended that the city trustees advertise for bids for its construction.

MARSHFIELD, ORE.—The town of Bandon is arranging to install a municipal water system. A special election has been called for February 25th, when the voters will pass on the question of issuing about $200,000 worth of bonds. Of this amount, it is planned to spend $150,000 on the water system.

TUCSON, ARIZ.—A. H. Frost, banker of San Diego, has petitioned the department of fomento, asking for a concession to use 5000 liters of water per second from Arroyo De Tijuana, Lower California, for the purpose of installing a water system in the town of Tiajuana for domestic use. The petition asked for the right to construct the needed dams within five years.

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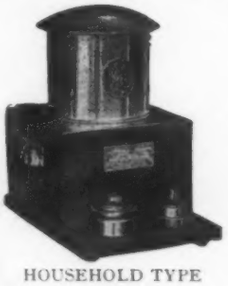

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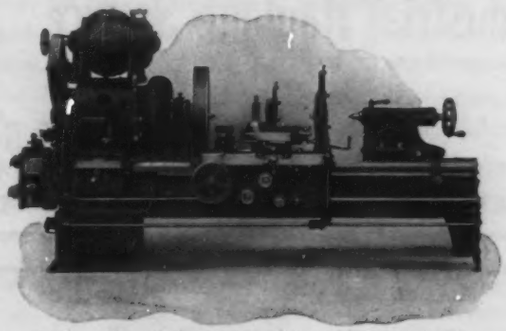

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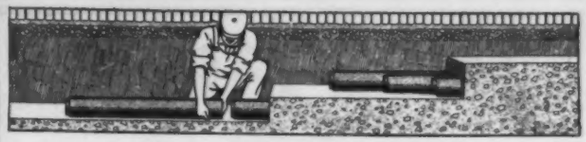

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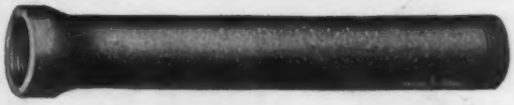

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American Ever-Ready Co.
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Electric Storage Battery Co.
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Batteries, Wet
Western Electric Company

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Pacific Mill & Mine SupplyCo.

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Gorham Engineering Co.

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Parker Boiler Co.
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General Electric Co.

Boxes, Wall
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"Multilet," Sprague Elec. Co.

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General Electric Company
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Pierson, Roeding Co.

Brackets, Steel Pole
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Paraffine Paint Co., The

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Okonite Company, The
Safety Ins. Wire & Cable Co.
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Kellogg Swbd. & Supply Co.

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Columbia Steel Co.

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"Weinland," Moore & Co., Chas. C.

Cleats, Porcelain
General Electric Company
Western Electric Company

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Benjamin Electric Mfg. Co
General Electric Company

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D. & W. Fuse Company
General Electric Company
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Western Electric Company

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Kellogg Swbd. & Supply Co.
Western Electric Company
Westinghouse E. & M. Co.

Coils, Spark
Western Electric Company

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Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

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Geo.E.DowPumpingEngineCo.
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"Fle.ductt," "Flexsteel," "National Metal Molding Co.
Sprague Electric Works.

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"Economy," "Sherarduct,"National Metal Molding Co.
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Sprague Electric Works.

Conduit, Underground
Johns-Manville Co., H. W.
Pierson, Roeding & Co.
Western Electric Company

Conduit, Vitrified Clay
"C. P. C.," Stewart-Fuller Co.

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Drendell Electric & Mfg. Co.
"E. E. E.," J. C. Farrar & Co.

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General Electric Company
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General Electric Company
The Cutler-Hammer Mfg. Co.
Westinghouse E. & M. Co.

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General Electric Company

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General Electric Company
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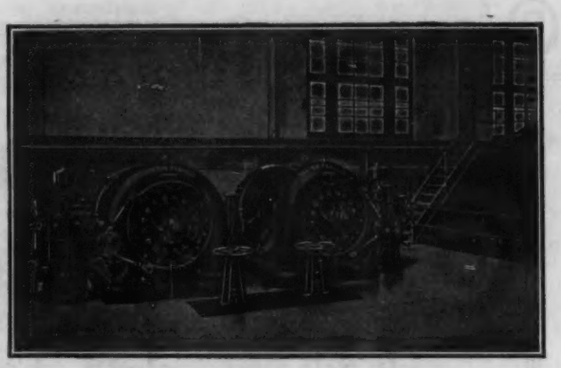

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